

ITEM WRITERS' GUIDELINES

for the

NUCLEAR CARDIOLOGY SPECIALTY EXAM

offered by the

NUCLEAR MEDICINE TECHNOLOGY CERTIFICATION BOARD

The purpose of this guide is to assist item writers in developing test questions (items) of the highest quality that will provide a reliable measure of an examinee's knowledge in the specialty of nuclear cardiology.

The role of the item writer in test development is very important and critical to the success of the examination. Each year, the NMTCB identifies individuals who are recognized experts in nuclear cardiology to participate in developing new items for the NMTCB's Nuclear Cardiology Specialty Examination. These Guidelines will assist item writers in writing technically sound multiple-choice test items.

Multiple-choice Tests

The multiple-choice format is generally regarded as being the most widely applicable and adaptable for the measurement of important learning objectives. This examination form has been adopted by the NMTCB, and has the advantages of efficient high-speed scanner scoring and effective psychometric analysis.

Every test item begins with an idea. Ideas selected for test items should be important in the practice of nuclear cardiology, and should be relevant to the purpose of the test; they should not be trivial bits of knowledge written to stump knowledgeable examinees. Therefore, the items developed for this examination should assess the knowledge of individuals who are practicing as specialists in the field of nuclear cardiology.

Once the topic of the item is determined, the next step is the construction of the stem. The stem should present examinees with all the information they will need in order to respond to the item. Examinees should not have to sift through the various alternative answers to determine the intent of the item, nor through unnecessary information in the stem that is unrelated to the intent of this item; this simply increases the time required to answer the item.

Once the stem has been written, the next step is to design a single keyed (correct) response. The final step, once the stem and keyed response have been developed, is to develop the three incorrect alternative responses (incorrect choices). These alternatives are designed to differentiate between those examinees who are nuclear cardiology specialists, from those who are not. The incorrect responses should not be written to trick examinees, but to discriminate between those examinees who truly know the answer and those who do not. Statements which are true in their own right, but are only peripherally related to the question asked, or choices that

would appear attractive to an examinee who does not know the correct answer, make excellent alternative responses.

Multiple-choice Item Forms

Regardless of the specific form of a multiple-choice item, each has three main parts:

1. a stem - a question or an incomplete statement presented to the examinee first;
2. the three incorrect alternative responses to the question - the incorrect responses to the stem;
3. the keyed response - the correct response to the question.

Diagrammatically, a multiple-choice item can be represented as follows:

1. presentation of question or problem (stem)
 - A. incorrect response] -----> (incorrect
 - B. incorrect response] -----> alternative
 - C. incorrect response] -----> responses)
 - * D. keyed response] (key)

The item stem should convey the question or problem in its entirety. The test of whether this criterion is met is to ask if a knowledgeable examinee could answer the question without looking at the choices. The keyed response must be the most acceptable of the four responses. Remember: the purpose of the incorrect alternatives is not to trick examinees, but to differentiate the examinees who are specialists from those who are not. The alternatives, "none of the above" or "all of the above" are to be avoided.

Multiple-choice items take several different forms. The forms selected for use on the NMTCB Specialty Examinations are:

Correct-answer form. One response is unequivocally correct. Factual information lends itself well to the correct-answer form (keyed responses are designated with an asterisk).

Example:

A patient's pulse should be measured at which anatomical location?

- A. temple
- B. ankle
- * C. wrist
- D. underarm

Best-answer form. The examinee is required to select the best answer from among those presented; the answer, however, may not be the best of all possible answers.

Example:

Which of the following radiopharmaceuticals should be used to evaluate myocardial viability?

- A. N-13 ammonia
- B. Tc-99m PYP
- C. Tc-99m labeled red blood cells
- * D. Tc-99m sestamibi

In this example, the best of all possible answers (based solely on the information available in the stem) generally is conceded to be F-18 FDG, which is not among the alternative responses provided. Note: the qualifier "of the following" is important because it excludes this option from consideration; Tc-99m sestamibi, thus becomes the best answer. Strictly speaking, if the stem states, "The radiopharmaceutical of choice to evaluate myocardial viability is...", the best answer would not be among the alternatives provided. In a simple item such as this, adding the qualifier may not be critical; nevertheless, neglecting such features can increase the ambiguity of any item, which, in turn, impairs test reliability.

Negative-approach form. The examinee is asked to identify the exception among the alternative responses. The examinee must select the INCORRECT or LEAST defensible response from among several correct or more satisfactory ones.

Example:

Which of the following is NOT a computer language?

- A. COBOL
- * B. FOTAL
- C. FORTRAN
- D. PASCAL

The negative aspect should be highlighted or capitalized; e.g., NOT, CANNOT, LEAST, NEVER, and FALSE. The question must be worded carefully to avoid confusion.

Example:

All of the following are likely to be helpful to a person in shock EXCEPT:

- A. giving oxygen
- * B. applying external heat
- C. placing the person in a dorsal recumbent position
- D. giving reassurance

Because this item form asks the examinee to identify the exception, the item writer must be extremely cautious when developing this type of item to ensure that the item is clear and unambiguous. Avoid using double negatives (having one negative in the stem and another in the response).

Sample Items

The following examples may assist writers by demonstrating the strengths of several items.

Example Item

Intrinsic bar phantom images taken over three days are compared. A significant degradation in spatial resolution is noted and most likely due to:

- A. incorrect detector orientation.
- B. a change of 4° in room temperature.
- * C. drift in the high-voltage power supply.
- D. damage to the collimator surface.

Comment

The task for this item is to perform spatial resolution checks on a scintillation camera. This is a good example of an item written in accordance with a specific task.

Example Item

A patient has received therapeutic 32-P colloidal chromic phosphate. The most likely source of radiation hazard to hospital personnel is:

- A. radiation exposure from handling the patient's urine.
- B. radiation exposure from handling the patient's stool.
- C. radiation exposure from the radionuclide inside the patient.
- * D. leakage from a puncture wound made during or after administration.

Comment

This item is well written because:

- ~ it has a single focus in the stem;
- ~ the stem is a complete question unto itself and could be answered without viewing any of the responses; and
- ~ all the incorrect responses have some relevance to the correct response and the stem.

Example Item

A technologist prepared Tc-99m macroaggregated albumin (MAA) by adding only one-tenth of the minimum recommended volume of Tc-99m pertechnetate. What is the most likely result?

- A. labeled particles will aggregate more rapidly
- B. the prepared radiopharmaceutical will be a nonhomogeneous suspension
- * C. a patient dose will have more than the recommended number of particles to be administered
- D. the radiopharmaceutical preparation will have particles that exceed the recommended size

Comment

This item requires the examinee to have a knowledge of a common radiopharmaceutical preparation, and to predict what will occur when the proper preparation procedure is not utilized. Although this item discusses radiopharmaceutical preparation, it is not specific to any individual manufacturer's kit.

Example Item

A technologist who schedules a 42-year old woman for a 3-phase bone scan of the foot must first determine if the patient:

- * A. has the possibility of being pregnant, or is nursing.
- B. is afraid of radiation.
- C. has a history of seizures.
- D. has had a recent foot X-ray.

Comment

An improvement in the responses could be made:

- ~ by removal of extraneous words from the first response; and
- ~ the correct response would then not be markedly longer than any other responses.

Improvement

- * A. is pregnant.
- B. is afraid of radiation.
- C. has a history of seizures.
- D. has had a recent radiograph of the foot.

Item Submission and References

The attached item development form is to be used to submit items to the NMTCB. If you would like to receive an electronic item submission document, please contact the NMTCB office. Each item must be supported with a reference, so the correct response to an item can be verified. A photocopy of the reference must be attached with the supporting information underlined. Items will not be considered by the Board without supporting reference material.

All submitted test items and accompanying figures, illustrations, images, etc. are CONFIDENTIAL and are the property of the NMTCB. The item writer cannot use any of the material submitted to the NMTCB in future publications, courses, presentations, exams, review sessions, etc.

Instructions regarding the submission of digital images:

- All patient identifiers must be removed before submitting images.
- The maximum size of any visual is 500 pixels high x 700 pixels wide. The window size is 5 1/2 x 8.
- To reduce byte size, only the image should be scanned, that is, white and black borders should be eliminated (this can also be accomplished by cropping the scanned image). Images can also be reduced or cropped before they are scanned to fit into the required space. Scanning heavy black lines should be avoided (if possible) because that type of line takes up a lot of space. For images with labels imbedded in a black border, please relabel image so that the border does not have to be scanned.
- The visuals should be saved in bitmap (.bmp) format.
- Once the images are copied onto a CD or diskette, they should be rechecked to ensure the image in fact was copied, is not too large, is not misaligned, and has not been cut off.

Item Writers' Checklist

An item for the NMTCB Nuclear Cardiology Specialty Exam is well written and appropriate if the

1. item asks a single question.
2. item is clear, complete and well-focused, and concerns a topic that experts in the field would agree is significant.
3. stem is direct, concise, and unambiguous.
4. stem includes all necessary, but no extraneous, information.
5. item has four responses.
6. stem and responses do not contain confusing double negatives or logical inconsistencies.
7. responses provide logically appropriate completions of the stem.
8. responses are homogeneous in focus, phrasing and length.
9. responses do not overlap with one another.
10. responses do not clue examinees who are less well prepared as to which response is correct.
11. keyed response is clearly the best of the choices offered as responses to the stem.
12. incorrect responses are plausible, but clearly not the best.
13. item does not contain jargon, slang, and nonstandard abbreviations.
14. item does not use information that is instrument-specific, kit-specific, or institutional protocol-dependent.