

## Guide Lines for Item Writing by National Board of Medical Examiners Problem-Based Learning and Use of Case Clusters

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An increasing number of medical schools have adopted problem-based learning (PBL) as an instructional strategy for portions of the basic science curriculum. Although each school's approach to PBL is somewhat unique, all involve the use of written patient cases (problems) in basic science instruction. Problems are designed to stimulate learning of material from traditional basic science disciplines (e.g., anatomy, physiology, biochemistry) from a clinical perspective, and application of basic science principles to clinical situations is stressed. Material is typically covered through independent study and discussed in small groups with a faculty tutor.

Well-written multiple-choice tests can play a major role in assessment, as long as they assess application of basic science knowledge to patient care. Tests using "case clusters" — multiple-choice questions associated with the same patient presentation are particularly appropriate for PBL courses.

An example of a simple case cluster is shown below.

- It consists of a brief case presentation, followed by a series of three multiple choice questions.
- Each question addresses a somewhat different aspect of the case, looking at the

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clinical situation from a variety of perspectives.

- Like PBL more generally, use of test material like this emphasizes learning of basic science information so that it is organized to be useful in provision of patient care.

- First, it is desirable to avoid "cueing" providing hints at the answers to earlier questions in later questions. Students are very likely to "read ahead" for these clues, and item writers should avoid providing them. For example, in a cluster describing a patient with chest pain, if the first question addresses the most likely cause of the pain and the second requires selection of the most appropriate drug treatment, it is important that each of the diagnoses associated with the first question have a "matching" drug in the second (and vice versa); test-wise examinees can rule out diagnoses (and drugs) simply by comparing the option lists.

- Second, it is desirable to avoid "hinging" creating questions where students must know the answer to one question in order to answer other questions unless the topic to be tested is so important that the item writer is willing to have students receive either all of the points or none of the points associated with a cluster.

The cluster prepared by Drs. David Felten and Ralph Jozefowicz for the final examination in the University of Rochester first-year Neural Science course, illustrates one strategy to avoid hinging.

- It can be difficult for a single faculty member to prepare case clusters where the items draw on information from several basic science disciplines this requires substantial breadth of knowledge.
- One strategy for coping with this problem is to adopt a "team approach" to preparation of test material analogous to the method generally used for preparation of problems for use in PBL instruction. For example, a clinician member of a team can prepare the patient description with which the cluster begins, along with questions related to pathophysiology.

A 34-year-old woman has had severe watery diarrhea for the past four days. Two months earlier she had infectious mononucleosis. She abuses drugs intravenously and has antibodies to HIV in her blood. Physical examination shows dehydration and marked muscle weakness.

1. Laboratory studies are most likely to show

- A. decreased serum K<sup>+</sup> concentration
- B. decreased serum Ca<sup>2+</sup> concentration
- C. increased serum HCO<sub>3</sub><sup>-</sup> concentration
- \*D increased serum Na<sup>+</sup> concentration
- E. increased serum pH

2. In evaluating the cause of the diarrhea, which of the following is most appropriate?

- A. Colonic biopsy to identify *Giardia lamblia*
- B. Culture of the oral cavity for *Candida albicans*
- C. Duodenal biopsy to identify *Entamoeba histolytica*
- D. Gastric aspirate to identify *Mycobacterium avium-intracellulare*
- \*E. Stool specimen to identify *Cryptosporidium*

3. Further studies to evaluate her HIV infection show the ratio of helper T lymphocytes to suppressor T lymphocytes to be 0.3. This occurs because HIV

- A. induces proliferation of helper T lymphocytes
- B. induces proliferation of suppressor T lymphocytes
- \*C infects cells with CD4 receptors
- D. infects macrophages
- E. stimulates the synthesis of leukotriene

An unresponsive 58-year-old woman is brought to the emergency department after collapsing at a local shopping mall. Her family reports that she felt well that morning but developed a headache that progressively worsened while she was shopping. She has had hypertension and atrial fibrillation and is taking an antihypertensive medication and an oral anticoagulant. Her blood pressure is 220/130 mm Hg and her respiratory pattern is one of apnea alternating with hyper apnea. She responds only to noxious stimuli with extensor posturing involving the right arm and leg. Fundoscopic examination reveals papilledema involving the left optic disc. Pupils are 3.0/7.0 (R!L) with no reaction to light on the left. There is a left gaze preference. There is diffuse hyper reflexia (R> L) and Babinski's sign is present bilaterally.

1. The dilated, unreactive left pupil is most consistent with injury to the left

- A. optic nerve
- B. optic tract
- \*C. oculomotor nerve
- D. lateral geniculate nucleus
- E. superior colliculus

2. The extensor posturing on the right is most consistent with injury to the left

- A. telencephalon
- B. diencephalon
- \*C. midbrain
- D. pons
- E. medulla

3. Her respiratory pattern is best described as

- A. normal
- \*B. Cheyne-Stokes
- C. central neurogenic hyperventilation
- D. apneustic
- E. ataxic

4. Which of the following herniation syndromes is most consistent with her clinical presentation?

- A. Cingulate gyms beneath the falx
- \*B. Temporal lobe uncus across the tentorium
- C. Diencephalon through the tentorial notch
- D. Brain stem through the tentorial notch
- E. Cerebellar tonsils through the foramen magnum

- Faculty members from relevant basic science disciplines can contribute items that address various aspects of the patient situation from the perspective of their discipline.
- Use of this kind of material is not, of course, restricted to curricula and courses taught using a PBL approach. It is

completely appropriate any time it is desirable to stress clinical application of basic science information in teaching, learning and assessment.

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