Certification

Reexamination of NMTCB Critical Task Survey: A Response to Changing Entry Level Practice

The Nuclear Medicine Technology Certification Board

The Nuclear Medicine Technology Certification Board (NMTCB) examination, a criterion referenced examination, tests job-related knowledge and skills necessary to practice as an entry level nuclear medicine technologist. To ensure that the examination is based on job-related knowledge, a Task Analysis was developed, which is the basis for the examination content as reflected in the examination matrix.

The Task Analysis is a listing of jobs performed by the entry level nuclear medicine technologist and must be continually updated to reflect changes occurring in the field. The results of the most recent validation survey in 1983 were published in the December 1984 issue of *JNMT* and beginning in September 1985 were incorporated into the examination (*1*). The previous task list and examination were validated in 1981 and published in the December 1982 issue of *JNMT* (*2*). Plans are now underway for a third survey, to be conducted in 1987.

Completing a survey, analyzing the information, publishing the data, and incorporating it into the examination usually requires 2-3 years. Based on information from the nuclear medicine community, the NMTCB believed that changes were occurring more rapidly in the field than had been anticipated, and it was decided that the examination should reflect some of those changes before completion of the third validation survey. Therefore, the 1983 validation survey data was reexamined.

Composite scores based on seven characteristics—performance, level of task, importance, frequency, time spent, consequence, and complexity—were used to reevaluate each task (*1*). First, those tasks with similar average composite scores were examined for correct classification as critical domain (CD) or associated domain (AD) tasks. The domain was changed for 21 tasks. More than one-half of the changes were in the Instrumentation group, in which tasks were changed from AD to CD, or core tasks. Next, 33 tasks were reviewed to avoid duplication in the different subgroups. For example, Task 152 from the Imaging subgroup, "verify patient identification and written orders for imaging procedure," and Task 191 from the Non-imaging subgroup, "verify patient identification and written orders for nonimaging procedure," are essentially the same task and should be tested only once. Twenty-seven tasks were determined to be true duplicates or triplicates; therefore, 14 tasks could be eliminated from the task list. Four tasks were omitted from the list because each was included within another task. Two tasks referring to rectilinear scanners were removed; one dealing with assessing accuracy and sensitivity of an assay was omitted because it was considered to be beyond entry level. The weights of the tasks, i.e., the number of items per exam, were also reviewed and 24 of them were changed. The primary changes occurred in the tasks associated with patient care in which weights were decreased.

The final analysis was a review of the tasks in Non-imaging that could be interpreted as radioimmunoassay (RIA) tasks. It was determined that 12 CD and 6 AD tasks from a total of 44 tasks possibly could be interpreted as RIA. Therefore, the absolute maximum percentage of RIA questions that could appear on the exam would be 9%. This, however, would be unlikely because the 6 AD tasks would be randomly selected, resulting in a more realistic proportion of 6% or 7%.

The major changes made with this interim task list and matrix are a reduction in the number of tasks by avoiding duplication of the same task in different subgroups, a greater emphasis on instrumentation, and a decrease in the weighted values of the tasks related to patient care and RIA. The exam matrix and task list that follow were approved by the NMTCB in April 1986, and will be incorporated into the September 1987 exam. The NMTCB is satisfied that this interim matrix and task list reflect changes occurring since 1983, and that the examination will continue to test the knowledge necessary for current practice at entry level.

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REFERENCES

1. Nuclear Medicine Technology Certification Board, NMTCB critical task validation study: Identification of entry level domain. *J Nucl Med Technol* 1984;12:192-200.

2. Nuclear Medicine Technology Certification Board, NMTCB certification examination validation report. *J Nucl Med Technol* 1982;10:210-22.

NMTCB EXAMINATION MATRIX

		Total Task Items	Selected Exam Questions
Group I	Radiation Protection and Radiopharmacy		
	Core Tasks (weight=2 or 3)	13	27
	Core Tasks (weight=1)	11	11
	AD Tasks	33	28*
	Subtotal		66 (33% of exam)
Group II	Instrumentation		
	Core Tasks (weight=2)	1	2
	Core Tasks (weight=1)	23	23
	AD Tasks	12	10*
	Subtotal		35 (17.5% of exam)
Group III	Imaging		
	Core Tasks (weight=2)	14	28
	Core Tasks (weight=1)	21	21
	AD Tasks	10	9*
	Subtotal		58 (29% of exam)
Group IV	Nonimaging		
	Core Tasks (weight=2)	0	0
	Core Tasks (weight=1)	22	22
	AD Tasks	22	19*
	Subtotal		41 (20.5% of exam)
	TOTAL		200

*These tasks will be randomly chosen for testing from the total number of AD tasks within each group.

Summary of Entry Level Domain on the Exam

		Core Tasks	Associated Tasks
Group I	Radiation Protection and Radiopharmacy	38	28
Group II	Instrumentation	25	10
Group III	Imaging	49	9
Group IV	Nonimaging	22	19
TOTAL		134 (67% of exam)	66 (33% of exam)

NMTCB Task Analysis of Nuclear Medicine Technology (Entry Level Practice)

Group I
RADIATION PROTECTION AND RADIOPHARMACY

Task	Domain	Weight
Compliance with Regulations:		
Post appropriate signs in designated areas to comply with NRC, agreement state, FDA, and JCAH regulations and standards.	AD	0–1
Package radioactive materials according to regulations.	AD	0–1
Maintain accurate written records of all radioactive material transfers to comply with NRC and agreement state regulations.	AD	0–1
Protection Procedures:		
Employ personnel monitoring devices.	AD	0–1
Employ patient monitoring devices.	AD	0–1
Review monthly personnel exposure records in regard to maximum permissible radiation dose limit.	AD	0–1
Take appropriate measures to reduce radiation exposure when necessary.	CD	1
Keep radiation exposure as low as is reasonably achievable using appropriate protection parameters continuously.	CD	2
Notify the appropriate authority of excessive radiation exposure.	AD	0–1
Notify the appropriate authority of misadministration, when applicable.	CD	1

Use proper shielding and the inverse square law to reduce radiation exposure.	CD	1
Use proper methods for the storage of radioactive drugs.	CD	1
Use proper procedures for those radioactive drugs that pose special hazards.	CD	1
Instruct the patient, family, and hospital staff in radiation safety precautions after administration of diagnostic and therapeutic radiopharmaceuticals.	AD	0–1
Provide instruction on proper radiation emergency procedures to be followed until radiation safety personnel arrive.	AD	0–1
Radiation Surveys:		
Perform radiation surveys.	AD	0–1
Use proper survey meters for each type and level of activity.	AD	0–1
Perform wipe test for surface contamination.	AD	0–1
Record data obtained from radiation surveys and QC on survey instruments in some standard format.	AD	0–1
Radiopharmaceutical Laboratory:		
Perform required procedures for maintenance of the radiopharmacy laboratory.	AD	0–1
Log receipt and wipe test results of radioactive materials for the maintenance of the radiopharmaceutical laboratory.	AD	0–1
Deface radiation symbol on boxes before discarding.	AD	0–1
Store nonradioactive supplies, including kits, appropriately.	AD	0–1
Generator Elution:*		
Assemble generator and shield with lead.	AD	0–1
Elute generator using aseptic technique.	CD	2
Assay the generator eluate using a dose calibrator or whole vial assay.	CD	2
Record the generator eluate assay results and time of assay in a log book.	AD	0–1
Check the eluate for radionuclide and chemical contamination and record results.	CD	2
*These tasks refer only to $^{99}Mo/^{99m}Tc$ generators.		
Radiopharmaceutical Compounding:		
Review daily work schedule and prepare appropriate radiopharmaceutical compounds.	CD	1
Determine within activity limits, the total volume and radioactivity to be added to a radiopharmaceutical kit and record the volume of the generator eluate used.	CD	2
Prepare radiopharmaceutical assay form for each lot of material.	AD	0–1
Check total activity in radiopharmaceutical reaction vials with a dose calibrator.	CD	2
Calculate the concentration of radioactivity of a compound and label vial as to date and time of preparation, lot number, concentration, and volume.	CD	2
Check all radiopharmaceutical preparations for proper pH, color, clarity, and particle size, if appropriate, and record on radiopharmaceutical assay form.	CD	2
Determine the radiochemical purity of radiopharmaceutical preparations by chromatography.	CD	1
Radiopharmaceutical Dispensing:		
Verify label on radiopharmaceutical vial, including concentration, specific activity, total activity, lot number, assay time, and date.	CD	1
Calculate residual activity using the appropriate decay factor for time elapsed.	CD	2
Calculate activity to be administered for diagnostic or therapeutic procedures.	CD	3
Calculate the volume or number of capsules of the radiopharmaceutical required for diagnostic and therapeutic procedures.	CD	2
Draw up correct volume of the radiopharmaceutical into a syringe, using aseptic technique and proper radiation safety precautions.	CD	2
Using a dose calibrator, verify the activity to be administered in the dispensed preparation.	CD	2
Verify that radionuclidic purity limits are not exceeded in the dispensed preparation.	CD	1
Record the patient name, examination, radiopharmaceutical activity, volume, lot number, time, date, and prescription number, if appropriate.	AD	0–1
Load radioactive gas into administration machine, if appropriate.	AD	0–1
Radiopharmaceutical Administration:		
Assemble proper materials for intravenous, gaseous, or oral administration.	AD	0–1
Waste Disposal:		
Dispose of radioactive material when appropriate.	CD	1
Monitor all radioactive vials and determine if acceptable to discard.	AD	0–1
Monitor alumina columns from generators to determine if acceptable to discard.	AD	0–1

Maintain long-term storage area to allow for the decay of radioactivity.	AD	0–1
Maintain log of radiopharmaceutical disposal.	AD	0–1
Decontamination:		
Perform decontamination procedures as required.	CD	1
Notify persons in the area that a spill has occurred.	AD	0–1
Cover the spill with absorbent paper to prevent spread.	AD	0–1
Check the area around the spill, hands, and clothing for contamination.	AD	0–1
Survey area to determine if contamination has been removed.	AD	0–1
Report the radioactive spill to the radiation safety officer.	AD	0–1
Record details of radioactive spill and corrective action in radiation survey log book.	AD	0–1

Note: Certain relevant aforementioned tasks refer only to commercially available radiopharmaceuticals.

Group II
INSTRUMENTATION

Task	Domain	Weight
Scintillation Spectrometers:		
Evaluate scintillation spectrometer performance on a routine basis.	CD	1
Calibrate a scintillation spectrometer.	CD	1
Determine percent full width at half maximum (FWHM) energy resolution on the scintillation spectrometer.	CD	1
Conduct sensitivity checks on the scintillation spectrometer.	CD	1
Check background.	AD	0–1
Determine cause for higher than normal background obtained on a scintillation spectrometer.	AD	0–1
Take a 60-cycle test count, if possible.	AD	0–1
Conduct a Chi square test on the scintillation spectrometer.	AD	0–1
Maintain records of scintillation spectrometer performance.	AD	0–1
Scintillation Camera:		
Select radionuclide source of appropriate activity and energy for scintillation camera uniformity check.	AD	0–1
Check pulse height analyzer (PHA) photopeak adjustment on the scintillation camera.	CD	1
Perform field uniformity check on the scintillation camera on a routine basis.	CD	2
Analyze field uniformity images.	CD	1
Differentiate source of nonuniformities using proper procedures, i.e., check collimator, pulse height analyzer peaking, detector, cathode ray tube, lenses, etc.	CD	1
Perform line distortion check on the scintillation camera on a routine basis.	CD	1
Identify any line distortion on the image.	CD	1
Determine source of line distortion, i.e., camera system components, detector-source geometry.	CD	1
Perform spatial resolution check on the scintillation camera on a routine basis.	CD	1
Use a high resolution phantom compatible with the specified resolution of the camera.	CD	1
Compare obtained resolution images with prior resolution images.	CD	1
Conduct sensitivity check on the scintillation camera.	CD	1
Maintain records of scintillation camera quality control—uniformity, linearity, resolution, sensitivity, and Chi-square testing.	CD	1
Recognize improper performance.	CD	1
Check the performance of image recording equipment, such as multiformatter.	CD	1
Perform lens focus check.	AD	0–1
Check and adjust cathode ray tube dot focus and shape.	AD	0–1
Maintain required records for quality control checks on image recording equipment.	AD	0–1
Gas Filled Detectors:		
Operate gas-filled detectors.	CD	1
Perform reference check source tests on survey instruments and compare with previous results.	CD	1
Determine the activity linearity of the dose calibrator over the entire range of radionuclide activity to be measured.	CD	1
Test accuracy of dose calibrator for commonly used radionuclides that have adequate reference standards available.	CD	1
Check for constancy of dose calibrator using a long-lived radionuclide standard.	CD	1

Maintain records of dose calibrator QC procedures as required.	AD	0–1
Computers:		
Perform basic computer operations.	CD	1
Maintain temperature and humidity levels for proper computer operation.	AD	0–1
Maintain data storage media (i.e., magnetic tape, disk, diskette).	AD	0–1

Group III
IMAGING

Task	Domain	Weight
Administrative Procedures:		
Maintain adequate supplies such as film, radiopharmaceutical kits, etc.	AD	0–1
Maintain auxiliary equipment used in imaging procedures.	AD	0–1
Schedule patient studies ensuring appropriateness, interact with hospital staff to effect proper and timely arrangement for patient study.	AD	0–1
Determine the most appropriate sequence for multiple procedures.	CD	1
Inform patient and nursing staff of appropriate standing and special orders, including medication and specimen collection.	CD	1
Maintain all appropriate records of patient procedures as required.	AD	0–1
Patient Care:		
Receive patient and provide proper nursing care during imaging procedure.	CD	1
Maintain good communication with patient, explain procedure, answer questions, and listen to patient's comments.	CD	2
Provide functionally safe and sanitary conditions for patient.	CD	1
Maintain intravenous fluids, oxygen, and other life-support equipment for patients.	CD	2
Recognize emergency conditions.	CD	2
Determine patient vital signs when necessary, including pulse rate, respiratory rate, temperature, and blood pressure.	CD	1
Administer cardiopulmonary resuscitation when necessary.	CD	1
Administer first aid.	CD	1
Maintain emergency cart.	AD	0–1
Patient Preparation:		
Verify patient identification and written orders for procedure.	CD	2
Check procedural contraindications and obtain pertinent patient history.	CD	2
Obtain informed consent when necessary.	AD	0–1
Check patient clothing for objects that may may attenuate radiation.	CD	1
Prepare patient with premedications, i.e., Lugol's, perchlorate, and instruct patient to void, etc. Include any necessary preparation for the procedure required.	CD	2
Transfer patient from wheelchair/stretcher to imaging table.	CD	1
Administer appropriate radiopharmaceutical by the proper route.	CD	2
Observe patient for possible reactions, after radiopharmaceutical administration.	CD	1
Discard contaminated materials in appropriate waste container.	AD	0–1
Wait appropriate length of time after administration of the radiopharmaceutical to begin imaging procedure.	CD	2
Imaging Procedure:		
Select proper instrument and auxiliary equipment necessary to perform imaging procedure as indicated by protocol.	CD	2
Prepare instrument for procedure, i.e., select proper collimator, imaging parameters, settings, etc.	CD	2
Select appropriate parameters for data acquisition using a computer.	CD	1
Select appropriate patient positions for procedure.	CD	2
Place patient in correct position using supportive materials and immobilizers to obtain scintigram for each view.	CD	1
Place electrocardiogram (ECG) leads in proper position for multigated acquisition studies.	AD	0–1
Determine the correct detector-to-patient distance.	CD	2
Indicate appropriate anatomical landmarks for each view of a procedure.	CD	2
Collect specimens according to imaging protocol, if applicable.	AD	0–1
Analyze image appearance and make adjustments if necessary.	CD	1

Check patient for contamination or other nonpathologic causes for abnormal image appearance.	CD	1
Perform special views as required.	CD	1
Process data acquired on computer.	CD	2
Perform all other necessary noncomputer data manipulations to achieve desired end product of imaging procedure.	AD	0–1
Process film according to manufacturer's specifications and film processor optimum operation.	CD	1
Review study to ensure correct information is supplied.	CD	1
Record information relative to any special circumstance affecting the procedure as needed.	CD	1
Review computer data acquired in imaging process prior to physician interpretation.	CD	1
Recognize artifacts caused by instrument malfunction, the radiopharmaceutical, the patient, or technologist error.	CD	1
Perform film processor quality control.	CD	1

Note: The aforementioned tasks apply to imaging procedures for the central nervous, endocrine, respiratory, cardiovascular, gastrointestinal, genitourinary, skeletal, hemopoietic, etc., organ systems.

Group IV
NON-IMAGING

Task	Domain	Weight
Laboratory Equipment:		
Check accuracy and operation of pipeting devices.	CD	1
Maintain constant temperature of water bath and refrigerators.	AD	0–1
Operate centrifuge and maintain routine tachometer checks.	CD	1
Calibrate and use laboratory scales and balances.	AD	0–1
Operate vortex mixers and shakers, maintaining constant conditions.	AD	0–1
Maintain quality control records of all laboratory equipment.	AD	0–1
Specimen Collection and Handling:		
Select proper equipment for blood collection (needles, syringes, etc.).	AD	0–1
Choose proper anticoagulant or preservative for specific procedure.	CD	1
Perform venipuncture at appropriate time intervals.	CD	1
Add hemolyzing compounds when necessary.	AD	0–1
Determine hematocrit.	CD	1
Centrifuge blood and separate blood components as required.	AD	0–1
Store aliquot of patient sample as dictated by the protocol.	AD	0–1
Add a preservative to urine container.	AD	0–1
Aliquot urine sample and measure total urine volume.	AD	0–1
Collect additional urine if volume collected is insufficient.	AD	0–1
Label cells with a radiopharmaceutical according to protocol for procedure.	CD	1
Standards and Controls:		
Choose appropriate volumetric glassware for dilution of the standard.	AD	0–1
Add a portion of solvent to glassware and a solution to prevent sticking.	AD	0–1
Add an amount of activity similar to that given to the patient and dilute up to the calibration mark.	CD	1
Assay Performance:		
Check expiration date of reagents.	AD	0–1
Determine if volume and activity of reagents are adequate to perform procedures.	AD	0–1
Allow assay components and patient specimens to equilibrate to room temperature.	CD	1
Prepare assay reagents.	AD	0–1
Add radioassay components according to protocol.	CD	1
Incubate standards and samples in the appropriate environment for the required time.	CD	1
Separate the bound from the free radioactivity using the necessary laboratory equipment and prepare sample for counting.	CD	1
Counting Equipment:		
Set pulse height analyzer on scintillation detector and center photopeak within analyzer settings chosen.	CD	1
Count assay samples, standards, and room background for a statistically significant number of counts.	CD	1
Outline organs to be counted externally if applicable.	AD	0–1

Calculations:		
Reduce data to net counts by subtracting room background.	AD	0–1
Calculate the desired fraction (bound/free, free/total, etc.) for generation of the standard curve *or* apply appropriate formulas including conversion and dilution factors.	CD	1
Plot above fractions obtained for the standards on the appropriate graph paper, *or* if necessary, plot graph, determine the half time (T½) and extrapolate to zero time.	CD	1
Determine final results for all patients and controls from the derived standard curve.	CD	1
Review procedure for possible technical errors that will alter the results.	CD	1
Record results on laboratory data record and on patient report form.	AD	0–1
Calculate organ ratios if applicable.	AD	0–1
Report both patient calculated values and normal range of the specific non-imaging procedure used.	CD	1
Quality Control:		
Perform quality control for all non-imaging procedures.	CD	1
Record daily results of all assay controls on quality control charts.	AD	0–1
Perform the appropriate control sera checks.	CD	1
Maintain records of antibody binding for each assay to note reagent deterioration.	AD	0–1
Recognize a significant shift in assay control and take appropriate action.	CD	1
Perform tasks necessary to assess the precision of all assays.	CD	1

Note: The aforementioned tasks apply to the following procedures and assays: blood volumes, (^{51}Cr and RISA), red cell survival and sequestration, thyroid uptake, stimulation and suppression, Schilling test; and hepatitis, vitamin B_{12}, folate, thyroid hormone, aminoglycoside, cortisol, and prolactin assays.