Nuclear Medicine Technology Certification Board (NMTCB) 1991 Critical Task Analysis Validation Report

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The Nuclear Medicine Technology Certification Board (NMTCB) Critical Task Survey process was described in the December 1991 issue of the *Journal of Nuclear Medicine Technology* (*1*). The role of a task validation survey in the development and updating of a criterion-referenced exam is well accepted and has been used historically by the NMTCB to ensure that the nuclear medicine certification exam reflects current practice (*2–5*).

This report reviews the data obtained in the NMTCB 1991 Critical Task Survey. A total of 371 surveys were included in the analysis with data collation provided by American College Testing (ACT). Since the last task analysis in 1987 included 172 surveys, the increased return rate for the most recent survey provides an added confidence level to the validity of responses.

Technologists, physicians, physicists, and radiopharmacists were sampled in the survey; 87.9% of all respondents were certified by the NMTCB. Although there were no responses from seven states, each region of the country was sampled and represented relative population densities.

Of all respondents, 74% stated that they spent more than 60% of their work day in clinical nuclear medicine practice while 83.8% of all respondents practice nuclear medicine in a hospital setting; 97% of all respondents perform imaging procedures in their department and 69.8% perform nonimaging procedures; 18.1% of all respondents stated they practice radioimmunoassay (RIA) procedures in their department (down from 40% in 1987); and 73.9% of all respondents who perform RIA stated they perform 0–100 RIA procedures each month.

Included in this survey were 104 tasks rated according to three characteristics, as follows.

1. *Frequency.* How often the task is performed.
2. *Performance Level.* If performed, when is a technologist expected to be able to perform the task (i.e.: at entry-level, or after the first year).
3. *Criticality.* What medical or institutional consequences result if the task is not performed competently.

The raw data for each characteristic on each task were averaged and standard deviations computed. The data supported the designation of all tasks as entry-level. Then, each task had a mean rating and standard deviation computed for the characteristics of frequency and criticality. These means and standard deviations were used as the primary database for designing the new test specifications for the NMTCB examination. Using the same process as in the 1987 data analysis, each task was examined rather than adopting a general percentage cut-off value to determine the fate of a task.

As a result of this process, several points were emphasized, as follows:

1. The survey indicated that the use of centralized radiopharmacies has increased substantially from the last survey, but the knowledge-base still has high criticality. No radiopharmacy tasks were dropped, and all tasks are classified as "critical domain."
2. Based on statistical evidence, nine RIA tasks were dropped from nonimaging. Related laboratory tasks (e.g.; determine hematocrit, operate a centrifuge, prepare a standard dilution, prepare specimens for analysis, etc.) were not dropped, based on evidence that many nonimaging procedures are still widely performed in nuclear medicine by nuclear medicine technologists.
3. Two tasks were combined with others based on their similar concepts. No new tasks were added.
4. The remaining 93 tasks were reclassified into four new subgroupings based on common factor analysis. With fewer tasks on the examination, the weighting assignments (or number of exam questions from each task) have changed. The redistribution of weights was determined after compiling information from equipment and procedure data included in the task analysis. Respondents reported increased performance by entry-level technologists of computer imaging, including SPECT imaging of all organs, computer data processing, and

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nuclear cardiology. Increased weight has been assigned to tasks pertaining to these areas. The updated equipment and procedures list is now available from the NMTCB office.

As in the past, the exam will be divided into critical and associated domains. Critical or core tasks will appear at least once on every examination; associated tasks, or those less frequently performed, will be randomly sampled. Only 3.5% of the exam is now in the associated domain.

The new NMTCB test specifications will be implemented with the September 1993 examination. The exam will continue to have 225 questions; 200 scorable items and 25 nonscorable pretest items. (See Appendix).

The NMTCB directors wish to thank the members of the nuclear medicine community who supported this project. Through their participation, the mission of the NMTCB examination is realized: Certification for nuclear medicine technologists by nuclear medicine technologists.

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APPENDIX

Summary of Entry-Level Domain on the NMTCB Exam Beginning September 1993

		Core Task (CD) Items	Associated Domain Task (AD) Items
Group I	Radiation Safety	33	1
Group II	Instrumentation	28	3
Group III	Clinical Procedures	82	3
Group IV	Radiopharmacy	50	0
	TOTAL	193 (96.5% of exam)	7 (3.5% of exam)

NMTCB Examination Test Specifications Beginning September 1993

		Total Task Items	Selected Exam Questions
Group I	Radiation Safety		
	Critical tasks (weight = 3)	3	9
	Critical tasks (weight = 2)	11	22
	Critical tasks (weight = 1)	2	2
	Associated tasks (weight = 0–1)	2	1
	Subtotal		34 (17% of exam)
Group II	Instrumentation		
	Critical tasks (weight = 4)	1	4
	Critical tasks (weight = 3)	2	6
	Critical tasks (weight = 2)	5	10
	Critical tasks (weight = 1)	8	8
	Associated tasks (weight = 0–1)	4	3
	Subtotal		31 (16% of exam)
Group III	Clinical Procedures		
	Critical tasks (weight = 6)	2	12
	Critical tasks (weight = 5)	2	10
	Critical tasks (weight = 4)	1	4
	Critical tasks (weight = 3)	7	21
	Critical tasks (weight = 2)	15	30
	Critical tasks (weight = 1)	5	5
	Associated tasks (weight = 0–1)	4	3
	Subtotal		85 (42% of exam)
Group IV	Radiopharmacy		
	Critical tasks (weight = 4)	1	4
	Critical tasks (weight = 3)	10	30
	Critical tasks (weight = 2)	8	16
	Subtotal		50 (25% of exam)

Group I Radiation Safety Tasks	Domain	Weight
Post appropriate signs in designated areas to comply with NRC regulations.	CD	2
Package radioactive materials according to regulations.	CD	1
Maintain accurate, written records of all radioactive material transfers to comply with NRC and agreement state regulations.	CD	2
Use personnel monitoring devices.	CD	2
Review monthly personnel exposure records with regard to maximum permissible radiation dose limits.	AD	0–1
Take appropriate measures to reduce radiation exposure when necessary.	CD	2
Notify the appropriate authority of excessive radiation exposure.	AD	0–1
Notify the appropriate authority of misadministration when applicable.	CD	2
Use proper shielding and the inverse square law to reduce radiation exposure.	CD	3
Use proper methods for the storage of radiopharmaceuticals that pose special hazards.	CD	2
Identify and use proper procedures for radiopharmaceuticals.	CD	3
Instruct the patient, family, and hospital staff in radiation safety precautions after the administration of diagnostic and therapeutic radiopharmaceuticals.	CD	2
Provide instruction on proper radiation emergency procedures to be followed.	CD	1
Perform wipe tests and area radiation surveys following a standardized schedule and format.	CD	3
Follow required procedures for receipt of radioactive materials.	CD	2
Appropriately dispose of radioactive material.	CD	2
Maintain a long-term storage area to allow for decay of radioactivity.	CD	2
Use proper procedures for managing a radioactive spill.	CD	2

Group II Instrumentation Tasks	Domain	Weight
Maintain appropriate instrumentation quality control records to comply with regulatory requirements.	CD	2
Calibrate a scintillation spectrometer.	CD	1
Determine the percent energy resolution of a scintillation spectrometer.	CD	1
Conduct sensitivity checks on the scintillation spectrometer or scintillation camera.	CD	1
Obtain background counts on a scintillation spectrometer.	AD	0–1
Perform a chi-square on the scintillation camera or spectrometer.	CD	1
Adjust pulse-height analyzer (PHA) on the scintillation spectrometer or camera for the appropriate photopeak.	CD	2

Group II Instrumentation Tasks	Domain	Weight
Perform field uniformity check on the scintillation camera on a routine basis.	CD	3
Perform detector linearity check on a scintillation camera on a routine basis.	CD	1
Perform spatial resolution check on a scintillation camera on a routine basis.	CD	3
Assess performance of image recording equipment.	CD	2
Perform reference check on survey meter.	CD	1
Ascertain the activity linearity of the dose calibrator over the entire range of radionuclide activity to be used.	CD	2
Test accuracy of dose calibrator for commonly used radionuclides.	CD	1
Check for constancy of dose calibrator using a long-lived radionuclide standard.	CD	2
Perform basic computer operations.	CD	4
Maintain proper environmental conditions for computer and associated equipment and supplies.	AD	0–1
Conduct temperature checks on water baths and refrigerators.	AD	0–1
Operate centrifuge and conduct routine tachometer checks.	AD	0–1
Calibrate and use single-sample well counter.	CD	1

Group III Clinical Procedures Tasks	Domain	Weight
Store and maintain adequate supplies including kits to assure timely completion of patient studies.	CD	2
Maintain auxiliary equipment as stated in the equipment procedures list.	AD	0–1
Schedule patient studies, ensuring appropriate sequence for multiple procedures, and interact with hospital staff regarding special orders.	CD	3
Maintain appropriate patient procedure records.	CD	2
Receive patient and provide proper nursing care during nuclear medicine procedure.	CD	2
Maintain good communication with patient by explaining procedure, answering questions, and listening to patient's comments.	CD	2
Provide functionally safe and sanitary conditions for patient.	CD	2
Recognize emergency conditions and determine patient's vital signs when necessary.	CD	2
Administer cardiopulmonary resuscitation and first aid when necessary.	CD	2
Receive patient and verify patient identification and written orders for study.	CD	1
Check procedural contraindications for study and obtain pertinent patient history.	CD	3
Obtain informed consent to perform study when necessary.	CD	2
Prepare patient for procedure as required.	CD	3

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Group III Clinical Procedures Tasks	Domain	Weight
Transfer patient from wheelchair or stretcher to the imaging table.	CD	1
Administer the appropriate radiopharmaceutical by the proper route.	CD	4
Discard contaminated materials in appropriate waste container.	CD	2
Wait appropriate length of time after administration of the radiopharmaceutical to begin imaging.	CD	3
Select and prepare proper instrument, computer, and auxiliary equipment necessary to perform imaging procedures as indicated by protocol.	CD	6
Place the patient in correct position, using supportive materials and immobilizers, and at appropriate distance from detector for obtaining each view.	CD	5
Indicate appropriate anatomical landmarks for each view of a procedure.	CD	1
Collect specimens according to imaging protocol if applicable.	AD	0–1
Analyze image appearance or computer information for normal structure and artifacts making adjustments if necessary, and assuring correct information is supplied.	CD	5
Perform any special views as required.	CD	3
Retrieve and process patient data acquired on a computer.	CD	6
Process film according to manufacturer's specifications and film processor optimum operation.	AD	0–1
Record information relative to any special circumstances affecting the procedure as needed.	CD	2
Perform film processor quality control.	AD	0–1
Determine hematocrit.	CD	1
Collect and process patient samples appropriately.	CD	2
Prepare a standard dilution.	CD	2
Prepare reagents and patient specimens for analysis.	CD	2
Count patient samples for statistically significant number of counts.	CD	2
Choose correct detector-patient distance for external counting and count for a statistically significant number of counts.	CD	2
Review nonimaging procedures for possible technical errors that may alter results.	CD	3
Perform calculations, as required, to determine final results for nonimaging procedures.	CD	3
Report both patient calculated values and the reference range for nonimaging procedures.	CD	1

Group IV Radiopharmacy Tasks	Domain	Weight
Assemble and elute a radionuclide generator using aseptic technique.	CD	3
Assay the activity of the generator eluate using a dose calibrator or whole vial assay.	CD	2
Check the generator eluate for radionuclide and chemical contamination.	CD	2
Review the daily work schedule to plan radiopharmaceutical needs.	CD	3
Prepare radiopharmaceutical compounds.	CD	3
Determine the total volume and radioactivity to be added to a radiopharmaceutical kit within activity limits.	CD	3
Check total activity in radiopharmaceutical reaction vials with a dose calibrator.	CD	3
Calculate the radioactivity of a compound and label vial as to date, time of preparation, lot number, concentration, and volume.	CD	3
Check all radiopharmaceutical preparations for proper pH, color, clarity, and particle size as appropriate.	CD	2
Determine the radiochemical purity of radiopharmaceutical preparations by chromatography.	CD	2
Verify label on radiopharmaceutical vial, including concentration, specific activity, total activity, lot number, assay time, and date.	CD	3
Calculate activity to be administered for diagnostic or therapeutic procedures.	CD	4
Determine the volume or number of capsules of the radiopharmaceutical required for diagnostic and therapeutic procedures.	CD	3
Withdraw correct volume of the radiopharmaceutical into a syringe using aseptic technique and proper radiation safety precautions.	CD	3
Using a dose calibrator, verify the activity to be administered in the dispensed preparation.	CD	2
Verify that radionuclide impurity limits are not exceeded in the dispensed preparation.	CD	2
Maintain appropriate radiopharmaceutical preparation and administration records to comply with regulatory requirements.	CD	3
Transfer radioactive gas or liquid into administration equipment if appropriate.	CD	2
Label cells with a radiopharmaceutical according to protocol for procedure.	CD	2