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## The Challenge of Environmental Radiation and Electrical Current in Probe Technology

by Kathy Thomas, MHA, CNMT, PET and Art Hall, CNMT, FSNMTS

Probe technology dates back to the early 1960's. It has been used to assess renal function as well as a variety of bioassay and sequestration studies. In today's clinical environment, probe technology, using instruments such as the Captus® 3000, can streamline patient workflow as well as perform and document regulatory procedures associated with bioassay for employees handling unsealed sources of radioactive iodine. The interesting challenge with probe technology is the very environment that it is used in – radiation and electricity!

Although probe technology is designed to detect radiation, its results can be adversely affected by radiation. Examples that may affect the accuracy of detected counts include:

- *Emitted radiation* from diagnostic imaging equipment can be detected by probe technology and may result in increased count rates during an uptake procedure. **Figure 1** illustrates a spike in count rate from a CT scanner that shares a wall with the uptake room. The wall has leaded shielding to 8 feet; however, there is an additional six feet above the lead shielding for AC duct work and electrical conduits that share a continuous open area.

- *Radioactive patients* undergoing diagnostic or therapeutic nuclear medicine procedures may also affect uptake values. The mantra that every technologist should remember is: millicuries trump microcuries every time. If the probe shares a room where radioactive patients are being imaged, injected, or walking through, the probe will detect the radioactive energy emitted from those patients. Rolling lead shields deflect a substantial portion of the radioactive energy emitted from those patients; however, shields alone will not stop radioactive energy that bounces off the walls, ceiling or floor and should not be relied on to eliminate radiation scatter.

- *Residual radiation* from previous nuclear medicine procedures may also adversely affect uptake values and other probe testing. It is important to determine if a patient has had a recent nuclear medicine study prior to initiating an uptake procedure. If there is any doubt, perform a pre-dose count of the patient to determine the level of residual radiation that may be detected during an uptake procedure.

(Continued on Page 2)

X-ray spike from CT scanner

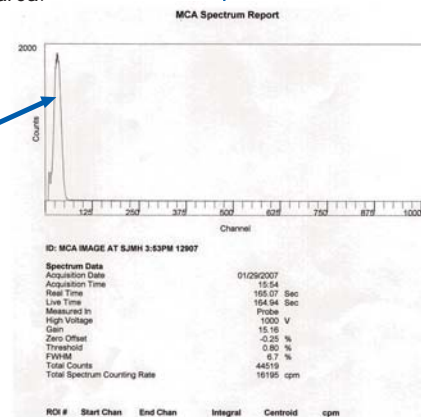


Fig. 1

## Probe Technology (...Continued from Page 1)

- **Radioactive contamination** of underwear/clothing will result in erroneous uptake values. Assess the patient for incontinence and normal urinary function prior to performing any uptake procedure.
- **Quality control** procedures, including the chi-square test can be affected by radiation detected from diagnostic imaging equipment and/or radioactive patients. If quality control procedures exceed expected values, take a look around to see what's in the environment that might be affecting those results.
- **Mislabeled sealed sources:** The rod sources supplied with a probe system are nominally calibrated at +/- 15%. These dedicated sources provide an excellent and reliable reproducibility check and energy calibration for the system. In the event that the sealed reference sources have an error factor that exceeds 15% of the recorded activity, it may alter the results of the probe's efficiency; however, that value is not used, and does not affect the clinical use or results of bioassays, lab tests or thyroid uptake values.

Electrical voltage can also affect uptake values.

- **A clean supply of electrical voltage** is required for the probe to accurately detect the energy pulse emitted by a radioactive source. If the voltage supply varies or has transient frequency interference during the day, it can affect quality control procedures that are used to assess the functionality of the instrument (chi-square, constancy, etc.) or patient counts. Voltage variability may result when:

- power is disrupted during an electrical storm
  - feedback of undesirable frequency on the neutral or ground line occurs
  - power is totally lost for a short or extended period of time
  - emergency power is initiated in the hospital
  - the demand for power exceeds the capabilities of the line supplying it.
- **Line voltage assessment** should be performed over a 24-48 hour time period if voltage variability is suspected. Contact your bioinstrumentation or engineering department for assistance.
  - **Powering the unit on/off** can affect the accuracy of results. Probe technology requires power to the detectors to maintain a fairly constant temperature; therefore, it's important to leave power to the unit on at all times.
  - **If power is lost** for more than 15 minutes:

- allow the unit to warm-up for 60 minutes
- recalibrate the unit by performing the morning quality control procedures to assure that the unit is functioning at an optimal level.

Other factors that can affect the accuracy of probe counts:

- **Attenuating material:** graphite, such as the material used in the positioning rod on the Captus® 3000, can attenuate up to 10% of the activity in the thyroid capsule if positioned directly over the capsule during the counting period. Metal and other materials may also have the same adverse effect; therefore, remove attenuating materials, such as the graphite rod, metal jewelry, etc. when counting a source or patient.

- **Geometry:** It's all about placement and distance.

- If a thyroid capsule is placed incorrectly in the thyroid phantom, the count rate may be reduced as much as 10%. (If the graphite rod is also attenuating counts, the combined error factor may decrease the capsule count rate by as much as 20%).

- If the distance between the radioactive source and the probe is inconsistent during counting, the count rate may be inappropriately increased or decreased, depending on the position of the probe to the source.

- Patient movement can alter results significantly. When the patient's neck tilts forward during the counting period, the count rate will increase. When the patient's neck relaxes away from the probe during the counting period, the total counts will be lower. To avoid this error, count the patient twice, making sure to check the patient's position before each count and whenever possible, perform the uptake procedure in a supine position to minimize patient motion.

- **Temperature:** It is important that the unit be in a controlled temperature environment. This is especially important when the instrument is in a clinic where the temperature may be altered significantly during week-ends and holidays. The instrument should be stored in an environment that maintains a constant room temperature.

Probe technology continues to play a useful role in nuclear medicine; however it's important to understand how certain key factors can affect the accuracy of the technology including radiation, electrical voltage, attenuating materials, geometry, temperature and patient positioning ■

**Although probe technology is designed to detect radiation, its results can be adversely affected by radiation.**



◀ Capintec introduces the new CRC®-25 Dose Calibrator line: having all of the capabilities of the CRC®-15 series, the CRC®-25 series has USB/PC communications, an SD flash card software upgrade, USB printer capability, chamber plug-and-play functionality and more!

# Capintec's SNM 2007 PREVIEW

**SNM Booth #1418**

A sneak preview of some of the many Capintec products that will be shown at SNM 2007. Visit us at Booth #1418 for more information, or to speak with a representative!

Give your Captus® 3000 the advantage of DICOM connectivity with the new Cap-DICOM™ software. Cap-DICOM™ adds DICOM modality worklist and DICOM export to the Captus® 3000. This solution allows patient information and demographics to be pulled from the Radiology Information System (RIS) or Hospital Information System (HIS), thus reducing errors and time associated with the manual input of patient information ▶



## Erratum

A typographical error from our Spring 2007 Newsletter on page 2 for the article entitled "Bioassays - Yesterday and Today" erroneously stated: "The counting period for each human bioassay was reported to be from 40 minutes to 40 hours!"

However, this sentence should read: "The counting period for each human bioassay was reported to be 40 minutes!"

For the article "The Mystery of CPM, DPM, CF, EFF, and MDA: Back to Basics," DPM should read:

"DPM: Radioactive decay as disintegrations per minute, calculated at a constant rate of  $2.22 \times 10^6$  disintegrations per minutes or  $3.7 \times 10^7$  disintegrations per second per 1 millicurie" ■

## Capintec Meeting Schedule

June 2-6	<b>SNM Annual Meeting</b>	Washington, DC
July 22-25	<b>AAPM Annual Meeting</b>	Minneapolis, MN
Sept. 6-9	<b>ASNC</b>	San Diego, CA
Sept. 8-11	<b>AMI/SMI Annual Meeting</b>	Providence, RI
Oct. 13-17	<b>EANM</b>	Copenhagen, Denmark

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## Technical Tips

In nuclear medicine, quality assurance procedures play an important role in assessing imaging and counting equipment used for patient care and personnel safety.

The following describes the quality control procedures for the CAPRAC® and CAPRAC®-R including Capintec's recommended time interval for performance for each procedure:

**BACKGROUND:** performed before initial use, on a daily basis and whenever there is a change in ambient room background. The background counts are automatically subtracted from subsequent wipe and/or test samples. Note: because the Caprac® is a very sensitive measuring device, it should be used only in areas of low background activity. When that is not possible, Capintec recommends the addition of lead shielding such as a customized auxiliary lead shield (5420-2072) to assure accurate measurements.

**TEST:** is a test of calibration and the internal operations of the unit and should be performed daily. The test of calibration:

- calculates the ratio of counts in certain channels to determine if the instrument is properly calibrated
- compares the difference between the calculated and measured activity of the reference source
- determines the ratio of certain channels to assure that the noise level of the unit is below the specified limit.

**AUTO CAL:** calibrates the high voltage of the unit to assure that the ratio of counts in certain channels is accurate. Auto Cal should be performed weekly, and when the TEST function measurement exceeds the expected parameters. Several conditions could cause the unit to fail Auto Cal:

- using the wrong standard reference source during calibration
- removing the standard reference source before the calibration is complete
- the presence of another source near the detector during calibration
- system malfunction.

**DIAGNOSTICS:** is a systems' test that assesses the instruments memories and programs. Diagnostics should be performed at the time of set-up and quarterly.

**CONTAMINATION TEST:** assesses possible contamination in the well or on the well liner. The contamination test should be performed at the beginning of each work day and on a weekly basis at the end of the work day.

The following table summarizes the recommended Quality Assurance Test Intervals for the CAPRAC® and CAPRAC®-R:

Description	Interval		
	Daily	Weekly	Quarterly
Test	X		
Background	X		
Auto Cal		X	
Diagnostics			X
Contamination Test	X	X	

For additional assistance, refer to your CAPRAC® user's manual or contact Capintec's Authorized Service Center at (412) 963-1988. If you have problems or issues that you'd like to have discussed in 'Technical Tips', please forward your questions to Kathy Thomas at [kthomas@capintec.com](mailto:kthomas@capintec.com) ■