TABLE 1
Light-Sensitive Cold Kits

Name of Cold Kit	Name of Radiopharmaceutical	Manufacturer
DMSA	^{99m}Tc-succimer (^{99m}Tc-DMSA)	Medi-Physics, Inc., Arlington Heights, IL
Hepatolite®	^{99m}Tc-disofenin	Du Pont Merck Pharmaceutical Co., Billerica, MA
Microlite®	^{99m}Tc-albumin colloid	Du Pont Merck Pharmaceutical Co., Billerica, MA
TechneScan MAG3®	^{99m}Tc-mertiatide (^{99m}Tc-MAG3)	Mallinckrodt Medical, Inc., St. Louis, MO
Syringe I* of UltraTag® RBC	^{99m}Tc-red blood cells	Mallinckrodt Medical, Inc., St. Louis, MO
Reaction vial† of OctreoScan®	^{111}In-pentetreotide	Mallinckrodt Medical, Inc., St. Louis, MO
Vial A‡ of Neurolite®	^{99m}Tc-bicisate	Du Pont Merck Pharmaceutical Co., Billerica, MA

*Syringe I contains 0.6 ml of 0.6 mg NaOCl.

†Reaction vial contains 10.0 μg pentetreotide, 2.0 mg gentisic acid, 4.9 mg sodium citrate, anhydrous, 0.37 mg citric acid, anhydrous, and 10.0 mg inositol.

‡Vial A contains 0.9 mg bicisate dihydrochloride (ECD · 2HCl), 24 mg mannitol, 0.36 mg edetate sodium, dihydrate, and 72 μg $SnCl_2 \cdot 2H_2O$.

fully comply with the *USP 23/NF 18* labeling requirement (*12*). Those two kit formulations are the Hepatolite kit, for the preparation of ^{99m}Tc-disofenin, and Neurolite.

Although the Hepatolite reaction vial states "protect from light" on the label, the outer cold kit box contains no warning statement regarding light sensitivity. It is also interesting to note that the Hepatolite reaction vials are stored in a so-called "convenience pack" carton. This 30-vial convenience pack has six 12-mm diameter circular openings for checking the re-order point of the cold kit supply without the need to open the outer box. In addition, the convenience pack also has an 11 cm × 3 cm opening for retrieval of the Hepatolite cold kits. These openings on the carton do not provide an adequate light-resistant environment for the cold kits, which are subject to photolytic degradation. The manufacturer should modify the storage box for Hepatolite® cold kits in order to provide proper protection for the light-sensitive kit formulation. In the meantime, since there is no indication of the light-sensitive level for the Hepatolite cold kit, the openings on the convenience pack should be properly covered to prevent light exposure of the cold kits.

The other cold kit formulation that violates the *USP 23/NF 18* labeling requirement (*12*) is the Neurolite cold kit, containing two sets of dual vials (i.e., vials A and B) (*10*). Although the label on vial A in the Neurolite cold kit does state "protect from light," the storage carton containing the two light-sensitive A vials contains no such cautionary statement. Each of the two sets of Neurolite cold kits must be kept inside the carton during storage. The storage carton cannot be removed and discarded until both sets of cold kits have been used.

The OctreoScan® cold kit was also recently approved by the FDA for the preparation of ^{111}In-pentetreotide for imaging primary and metastatic neuroendocrine tumors bearing somatostatin receptors (*13*). Both the OctreoScan reaction vial pack label and the outer storage carton box bear the cautionary statement "protect from light." Since the label of the 10-ml vial for $^{111}InCl_3$ solution does not contain any cautionary statement regarding light sensitivity, it would indicate that the contents in the OctreoScan reaction vial (Table 1) are light sensitive. Although the reaction vial is packaged appropriately, it is interesting to note that the package insert for the OctreoScan kit does not include any warning statement regarding light sensitivity of the contents of the reaction vial (*13*).

Joseph C. Hung
Mayo Clinic
Rochester, Minnesota

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A TECHNIQUE FOR MEASUREMENT OF STRONTIUM-89 IN A DOSE CALIBRATOR

To the Editor: The following technical comments are offered in response to the article published in the

March 1995 *Journal of Nuclear Medicine Technology* entitled "A Technique for Measurement of Strontium-89 in a Dose Calibrator (*1*)."

Capintec is pleased that the Mayo Clinic has developed a method for the successful measurement of ^{89}Sr using a Capintec CRC-12R dose calibrator. In addition, we concur with the authors' position that it is a good quality assurance practice to confirm the activity of all dosages determined by volumetric calculation through the use of a suitable measurement device. However, the successful use of a conventional dose calibrator for measurement of pure high-energy beta emitters requires a clear understanding of the limitations inherent in the use of a well-type ionization chamber for this purpose. Because of the low ratio of bremsstrahlung production per unit of activity, dose calibrator ionization chambers produce extremely low levels of current during measurement of pure beta emitters. Calibration factors generally require a multiplier (typically × 100), and displayed readings fluctuate more with beta than with gamma emitters. Dose calibrators do not possess energy discrimination abilities. Strontium-89 contains small amounts of radioactive ^{85}Sr and this trace impurity can vary with target material. Since ^{85}Sr produces a 514-keV gamma at 98%, this variability can cause significant errors when measuring ^{89}Sr in a dose calibrator. In addition, the slight variability between ionization chambers, normally undetectable in the energy ranges typically used in nuclear medicine, becomes significant when measuring bremsstrahlung and contributes to calibration difficulties.

The author cites costly liquid scintillation counters as an alternative method of measurement. However, the inconvenience of using an aliquot and the wait for results make this technique impractical for routine use in a clinical environment.

To meet the need for a practical assay method for pure high-energy beta-emitting radiopharmaceuticals, Capintec has developed a new type of dose calibrator, the Beta-C Counter. This device utilizes a thin-crystal sodium iodide detector optimized for sensitivity to bremsstrahlung and a six-channel pulse-height analyzer to provide sufficient energy discrimination to separate bremsstrahlung spectrum from higher-energy gamma-emitting impurities. This provides a significant improvement in accuracy over the conventional dose calibrator. In addition, sample holders provide a fixed geometry which places the vial perpendicular to the face of the crystal. Since the wall thickness of a vial varies less than the bottom thickness from lot to lot, this positioning minimizes container variability. The source-to-detector distance has been set to accommodate the clinical activity range of interest without the need to aliquot.

Beta-C instrument comparisons have shown variability of less than ±3% under typical lab conditions, compared to ±10% found with the conventional dose calibrator. Precision is also significantly improved. With counting times as short as 2 sec, counting errors of less than 1% are achieved. The unit is less expensive than the conventional dose calibrator and, given cost containment considerations, can also function as a calibrator for low activity levels of gamma emitters provided it has been calibrated appropriately for each nuclide.

Mary Anne Dell
Capintec, Inc.
Pittsburgh, Pennsylvania

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To the Editor: We read with interest the article by Herold et al. (*1*) regarding the dose calibrator measurement of ^{89}Sr. We employed a virtually identical approach approximately two years ago when establishing the calibration settings for our Capintec CRC 15R.

In addition to the required posting of these settings on the dose calibrator we require all personnel who would potentially be involved in preparing a dose of ^{89}Sr to review and sign a copy of the procedure.

One technical point we wish to address pertains to the two measurements which are taken of the original vial of ^{89}Sr. We feel that the measurement of residual activity in the empty vial at the same setting as the full vial may be inappropriate. It should be performed only after adding a sufficient volume of saline to the vial to re-establish the original volume (in most cases 4 ml). A correction factor (or another setting) for measuring the vial after removal of a dose can then be established. The measured activity of a soft gamma or pure beta-emitting radionuclide will vary significantly between what may essentially be considered a point source and when dispersed in a larger volume. In order to establish the magnitude of this potential error, the residual activity was measured in twelve empty vials of Metastron® and remeasured after adding 4 ml of 0.9% NaCl. The results are shown in Table 1.

Additionally, the theoretical self-absorption of the ^{89}Sr beta emission from a cylinder of water 15 mm high and 19 mm in diameter within a glass vial of approximately 1 mm thickness was calculated by integration and compared with an essentially unattenuated point source within the same glass vial. The calculated value is 17.34%. This value is in close agreement with the geometric variation derived from our experimental data.

Admittedly, this is somewhat academic for single-dose vials. However, for multidose vials of pure beta emitting radiopharmaceuticals this geometric correction cannot be ignored. Additionally, the NRC has recently clarified its position on the assay of pure beta-emitters by issuing an informational notice (*2*). The NRC states:

> Part 35 does not require licensees to measure patient dosages of radiopharmaceuticals containing pure beta-emitters provided they are unit dosages obtained from a manufacturer or preparer licensed pursuant to 10 CFR 32.72 or equivalent Agreement State requirements. Otherwise, the licensee is required to measure by direct measurement, or by combination of measurements and calculations, the activity of each dosage of an alpha- or