# Radiopharmacy

## A Fingertip Shield for Safe and Effective Disinfection of a Radiopharmaceutical Vial

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***We evaluate a shielding device designed to safely and simply wipe the top of radiopharmaceutical vials. In addition to reducing fingertip dose and facilitating ease of operation, the shield enables the technologist to thoroughly disinfect the vial top.***

The "as low as reasonably achievable" (ALARA) concept commits the nuclear medicine technologist to maintain body and extremity exposures at minimum levels. It is common practice in all nuclear medicine laboratories to prepare labeled radiopharmaceutical vial tops with an alcohol wipe prior to entry into the vial (Fig. 1). It is necessary to wipe the vial to reduce the amount of bacteria on the vial top. However, the effectiveness of the wiping procedure is generally compromised by the shortened contact times that result from the technologist's knowledge of possible high exposure levels at the vial surface. Recognizing this problem, the need for a simple, effective, and protective shielding device for vial wiping becomes evident.

### Materials and Methods

Our first step was to determine a standard vial wipe time at which bacteria on the vial top would be reduced to aseptic levels and permit dose determinations to be made. Using the hospital bacteriology laboratory, cultures were run of vials inoculated with *S. aureus* and *E. Coli* and cultured on chocolate culture media *(1)*. They were then wiped at various time intervals with 70% isopropyl alcohol. During the two trials, each vial diaphragm averaged 1 million organisms. The results showed that a wipe time of 3 to 5 sec produced bacterial levels within acceptable limits (Table 1). For this experiment, 5 sec was used as the standard wipe time per vial.

Next, four trials were conducted, using groups of 50 thermoluminescent dosimeters (TLD) that were exposed to vials containing Tc-99m at activities ranging from 250 to 585 mCi. LiF TLD-100 chips were calibrated against a Co-60 teletherapy source and read using a Victoreen model 2800 TLD reader *(2)*. The TLD was placed on the vial diaphragm and exposed for 50 sec. (Because a single wiping would give only a low level exposure, each TLD was exposed for 50 sec to simulate ten wipes, which improved the statistical accuracy of the dose determinations.) The dose received while wiping a vial was approximately 1.1 mRad/100 mCi sec (Table 2).

**FIG. 1.** Present means of preparing radiopharmaceutical vial tops with a 70% isopropyl alcohol wipe.

The effect of vial volume on the dose rate at the diaphragm surface was evaluated. Again the TLD's were exposed for 50 sec using a constant activity and varying the vial volume by adding 5-cc increments of normal saline. Results indicated that the vial volume had no significant effect on the measured dose rate (Table 3).

A shielding device was designed to reduce fingertip dose during vial wiping (Fig. 2). The device consists of three components: a lead disk 3 in. in diameter, ½ in. in thickness. [½ in. of lead represents 57.7 half value layers with a theoretical transmission factor of $4 \times 10^{-18}$ *(3)*] with a 7/32-in. hole through its center; a small cabinet handle also having a 7/32-in. hole through its center; and six ¼-in. flat

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**TABLE 1. Effect of Wipe Time on Number of Colonies Cultured and Percent Bacteria Killed**

| Wipe Time (sec) | Number of Colonies Cultured | % Bacteria Killed |
|---|---|---|
| 0 | 1000 | 0 |
| 1 | 307-352 | 65-70 |
| 2 | 164-207 | 80-85 |
| 3 | 12-37 | 95-99 |
| 4 | 6-8 | 99 |
| 5 | 0 | 100 |
| 10 | 0 | 100 |

**TABLE 2. Approximate Dose Rates for Various Tc-99m Activities**

| Activity (mCi) | Dose mrad/sec | Dose mrad/5 sec |
|---|---|---|
| 500 | 5.5 | 27.5 |
| 1000 | 11.0 | 55.0 |
| 1500 | 16.5 | 82.5 |
| 2000 | 22.0 | 110.0 |
| 2500 | 27.5 | 137.5 |
| 3000 | 33.0 | 165.0 |
| 3500 | 38.5 | 192.5 |
| 4000 | 44.0 | 220.0 |
| 4500 | 49.5 | 247.5 |
| 5000 | 55.0 | 275.0 |

**TABLE 3. Effect of Vial Volume on Dose Measured at Vial Diaphragm**

| Volume (ml) | Dose Measured (mrads) Trial 1 | Trial 2 |
|---|---|---|
| 5 | 320 | 500 |
| 10 | 300 | 510 |
| 15 | 310 | 490 |
| 20 | 300 | 490 |
| 25 | 320 | 500 |

washers connected by a 7/32 × 2-in. steel bolt. The washers are covered with Velcro™ and form a plunger that will come in contact with the wipe. The plunger, disk, and handle are connected with the 7/32-in. bolt and are locked together by a 7/32-in. nut. The shield is used as follows:

1. Using long forceps, place the alcohol wipe over the vial diaphragm.
2. With the wipe in place, position the bottom of the plunger so that it comes in contact with the vial diaphragm (Fig. 3).
3. Rotate the shield by turning the handle.
4. Remove the shield from the vial diaphragm.
5. Using long forcepts, remove the used wipe from the plunger.
6. Dispose of the used wipe in a radioactive waste container.

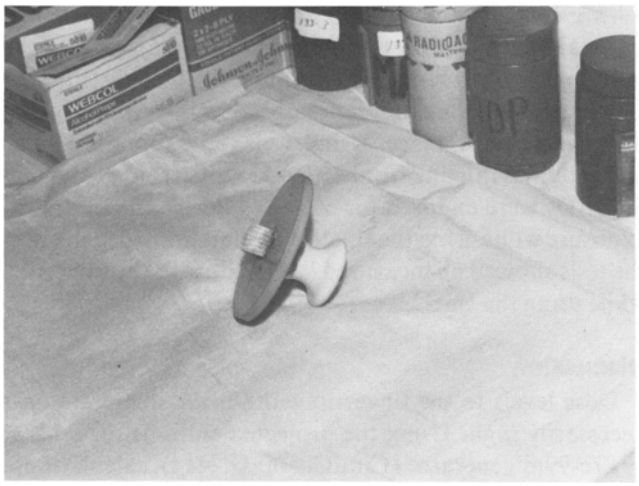

**FIG. 2.** Shielding device that can eliminate fingertip exposure incurred during vial wiping.

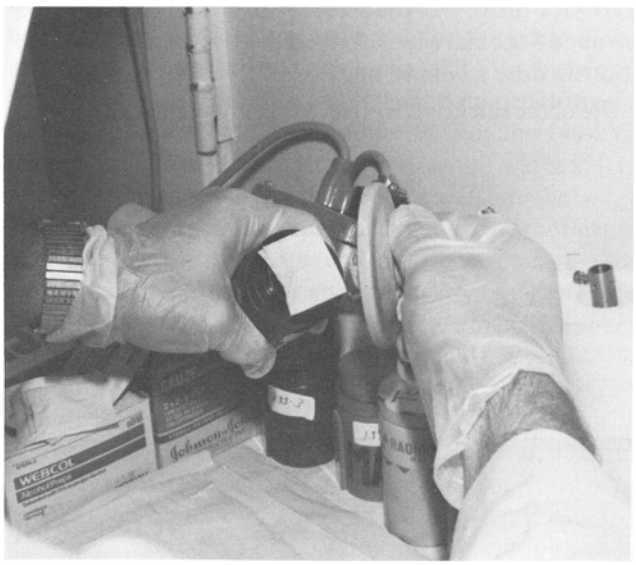

**FIG. 3.** Shield about to be placed on vial in order to disinfect the vial top.

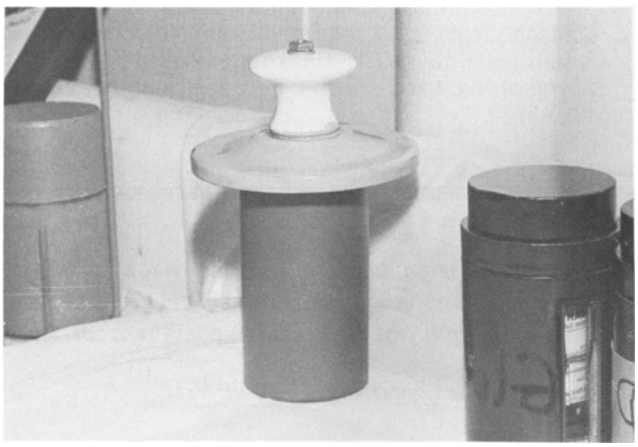

**FIG. 4.** Shield stored in a modified vial shield to eliminate possible area contamination from plunger.

7. To eliminate the possible spread of radioactive contamination from the plunger to the adjacent work area, store the shield in a radioactive vial pig (Fig. 4).

The final step is to measure dose levels during wiping with the shield in place. Using a vial containing Tc-99m and activities ranging from 250 to 585 mCi, four groups of 50 TLDs were exposed for 50 sec to determine fingertip exposure while using the shield. The data recorded during the tests showed no measured level of dose to the fingertip while using the shield.

## Discussion

Dose levels to the fingertip without the shield are unnecessarily high. Using the projected elutions for a Mo-99/Tc-99m generator (CintiChem, GN414), calculations were made to determine the radiation dose to the fingertip during our normal daily lab preparations (Table 4). The preparations included: glucoheptonate (300 mCi), sulfur colloid (100 mCi), MAA (100 mCi), MDP (100 mCi), and HIDA (50 mCi). Our total weekly dose was found to be 2.3 rad upon 5-sec vial wipes. At this rate, the yearly (50 weeks) fingertip dose would be approximately 120 rads.

Use of the shield is effective in reducing fingertip dose incurred during vial wiping to background levels. The shield is also simple to use and will enable the technologist to reduce the amount of bacteria on the vial top to aseptic levels. The shield can be constructed for less than $10.

**TABLE 4. Estimation of Radiation Dose to Fingertip Incurred during Normal Days of Lab Preparation**

| Day | Tc-99m Elution (mCi) | Dose (mrad/day) |
|---|---|---|
| 1 Wed. | 3,020 | 727 |
| 2 Thurs. | 2,347 | 559 |
| 3 Fri. | 1,824 | 429 |
| 4 Sat. | 1,417 | 335 |
| 5 Mon. | 857 | 193 |
| 6 Tues. | 666 | 147 |

## References


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2. Cameron JR, Suntharalingam N, Kenney GN. *Thermoluminescent Dosimetry*. Milwaukee, The University of Wisconsin Press, 1968; 28.

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