

# Radiation reduction during diagnostic and interventional procedures utilizing a novel portable radiation shielding system

## Background

Radiation exposure during invasive cardiovascular procedures remains at the upper-range of diagnostic studies, and it is even higher in complex electrophysiologic, coronary, and structural heart interventions. Traditionally, lead aprons and shields (LAS) have been used to reduce the cardiovascular care team's radiation exposure. A fully portable radiation shielding system (PRSS) was developed as a viable alternative to traditional lead aprons and shields.

## Methods

Catheterization laboratory teams were randomized in a 1:1 fashion to perform elective procedures wearing either traditional lead aprons or with the use of the PRSS. Radiation exposure was measured using a real time dosimetry monitor placed in pre-specified anatomic locations on three team members. Radiation attenuation was collected on a per case basis.

**Table 1: Radiation exposure by operator position and shielding mechanism**

| Position           | Location           | Mean (SD)          | Min            | Max       | P-value   |       |
|--------------------|--------------------|--------------------|----------------|-----------|-----------|-------|
| Position 1         | Head               | 2.2 (1.3,3.9)      | 0.2            | (0.1,0.4) | <.001     |       |
|                    | Thyroid above lead | 1.2 (0.5,2.3)      | 0.2            | (0.1,0.4) | <.001     |       |
|                    | Chest above lead   | 1.5 (0.7,3.9)      | 0.2            | (0.1,0.4) | <.001     |       |
|                    | Chest below lead   | 0.0 (0.0,0.1)      | 0.2            | (0.1,0.4) | <.001     |       |
|                    | Axilla             | 1.9 (0.5,3.4)      | 0.2            | (0.1,0.4) | <.001     |       |
|                    | Forearm            | 4.3 (2.3,8.9)      | 0.4            | (0.3,0.7) | <.001     |       |
|                    | Hip below lead     | 0 (0,0.2)          | 0.2            | (0.1,0.7) | <.001     |       |
|                    | Mid Tibia          | 2.3 (1.3,3.9)      | 0.2            | (0.1,0.4) | <.001     |       |
|                    | Position 2         | Head               | 1.7 (1.0,2.5)  | 0.1       | (0.1,0.3) | <.001 |
| Thyroid above lead |                    | 1.7 (1.0,2.7)      | 0.2            | (0.1,0.4) | <.001     |       |
| Chest above lead   |                    | 2.8 (1.3,4.9)      | 0.3            | (0.1,0.4) | <.001     |       |
| Chest below lead   |                    | 0.1 (0.0,0.1)      | 0.3            | (0.1,0.4) | <.001     |       |
| Axilla             |                    | 2.6 (1.8,4.9)      | 0.2            | (0.1,0.4) | <.001     |       |
| Forearm            |                    | 5.5 (2.9,11.1)     | 0.4            | (0.1,0.6) | <.001     |       |
| Hip below lead     |                    | 0.1 (0.0,0.4)      | 0.1            | (0.0,0.3) | 0.9336    |       |
| Mid Tibia          |                    | 2.9 (1.8,9.0)      | 0.2            | (0.1,0.4) | <.001     |       |
| Position 3         |                    | Head               | 1.0 (0.5,1.4)  | 0.1       | (0.0,0.2) | <.001 |
|                    |                    | Thyroid above lead | 0.5 (0.3,1.2)  | 0.1       | (0.0,0.2) | <.001 |
|                    |                    | Chest above lead   | 0.5 (0.3,1.0)  | 0.1       | (0.0,0.2) | <.001 |
|                    | Chest below lead   | NA                 | NA             | NA        |           |       |
|                    | Axilla             | 0.6 (0.3,1.0)      | 0.0            | (0.0,0.1) | <.001     |       |
|                    | Forearm            | 0.9 (0.6,1.5)      | 0.2            | (0.1,0.3) | <.001     |       |
|                    | Hip below lead     | 0.0 (0.0, 0.0)     | 0.1 (0.0, 0.2) |           | 0.8927    |       |

LAS=Lead aprons and shields; PRSS=portable radiation shielding system. Radiation exposure in mRem

## Results

The institutional IRB approved 100 procedures for this study. Diagnostic left heart catheterizations, percutaneous coronary interventions, and structural heart procedures were included in the analysis. Fluoroscopy time (15.4 (7.3,30.6) mins LAS vs. 12.3 (5.1,28.6) mins PRSS  $p=0.52$ ) and radiation dose per case (376.5 (226,1037) mGy LAS vs. 288 (123,531) mGy PRSS  $=0.52$ ) were similar between groups. Results are summarized in Table 1.

## Conclusions

A novel PRSS significantly reduces radiation exposure to the cardiovascular care team compared to standard lead aprons and shields. The system decreases radiation exposure to areas not routinely protected by traditional lead aprons and shields (head, lower legs, arms, and hands).