

### Purpose:

We investigated the severity of partial volume effects (PVE) in SPECT oncology studies when images are reconstructed by four different algorithms.

### Methods:

We simulated an oncology SPECT scan with three spherical objects (diameter of 4.4cm, volume of 61mL) representing tumors. These objects were filled with different activities and positioned inside a large cylinder imitating the human body. Our tumor-like objects were not only surrounded by low-activity tissues, but also placed next to some organ (for example, liver) with variable activity. We simulated a typical oncology SPECT scan with 60 camera stops over a 360 degree rotation. In total, four methods with increasing complexity were employed to reconstruct images. The first algorithm, M1, included corrections for attenuation and resolution loss and imitated techniques conventionally used in clinics. Method M2 additionally incorporated model-based scatter correction. Methods M3 and M4 employed the known (from structural imaging modalities) boundaries of tumor(s) and corrected activity inside tumor(s) for spill-out only (simplified technique M3) or iteratively updated both tumor(s) and background accounting for both spill-in and spill-out (advanced technique M4).

### Results:

Incorporation of model-based scatter correction (method M2) improved the quantification for all tumor-like objects. Method M1 underestimated tumor activities by 20-25%, whereas method M2 underestimated these activities by only 12-15%. Both PVE corrections M3 and M4 led to substantially better activity estimations with errors of 0-5%. In addition, method M4 provided the best activity distribution in regions encompassing tumors. The relative error of the voxelized activity distribution in that surrounding region was 20-27% for method M1, 19-25% for method M2, 15-18% for method M3, and 12-13% for method M4.

### Conclusions:

The SPECT-generated activity distribution can be considerably improved by using template-based corrections for PVE. Correspondingly, the quality of procedures such as tumor staging, estimating response to treatment, and patient-specific dosimetry can be enhanced.