# THE CRITICAL ROLE OF STANDARDIZED HEIGHT MEASUREMENT IN PET/CT RESPONSE ASSESSMENT: POST-INTERVENTION AUDIT AND TRAINING INITIATIVE

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## ABSTRACT

In oncological imaging, $^{18}$F-FDG PET/CT serves as a cornerstone for metabolic response assessment. While maximum standardized uptake value (SUVmax) has traditionally been used to measure metabolic activity, emerging clinical practice increasingly favors the PERCIST (PET Response Criteria in Solid Tumours) criteria, which relies on the Standardized Uptake Value normalized to Lean Body Mass (LBM) than body weight (SUL). This follow-up audit highlights the impact of training of technologists for standardized height measurements which is fundamental towards the accuracy of SUL and interpretation of metabolic response to the treatment.

## Introduction

**Why Precise Anthropometrics Matter**

Accurate measurement of height is not merely a routine clinical task; it is a vital diagnostic component in modern PET imaging.

• **SUL vs. SUV:** SUV is a commonly used PET parameter to measure the uptake of various radiopharmaceuticals, mainly $^{18}$F-FDG, in normal tissues and lesions. SUV is simply the ratio of the activity concentration in the target tissue or lesion to the activity concentration in the whole body:

SUV = Tissue Activity Concentration (kBq/ml)
Injected Dose (MBq) / Body Weight (kg)

This equation assumes that the injected activity is uniformly distributed in the whole body and that 1 cm$^3$ of tissue weighs 1 g.[1] Unlike SUV, which is calculated based on total body weight, SUL is normalized to Lean Body Mass (LBM). SUL allows for a better comparison of the PET images of a patient whose weight has changed significantly between PET studies. Weight changes, particularly loss, are common in oncologic patients because of treatments or disease progression. SUV will be overestimated when the patient is overweight or obese and underestimated when the patient is underweight or has cachexia.[1]

• **The BMI and LBM Link:** SUL calculations utilize the Body Mass Index (BMI), which is derived directly from the patient's height and weight. LBM is calculated according to the formula of Janmahasatian et al:[2]

$LBM^M = 9{,}270 \times \text{weight} / (6{,}680 + 216 \times \text{BMI})$
$LBM^F = 9{,}270 \times \text{weight} / (8{,}780 + 244 \times \text{BMI})$

where $LBM^M$ and $LBM^F$ are the LBM for males and females respectively, and BMI is body mass index (weight/height$^2$), and weight and height are in kilograms

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and meters, respectively. These formulas are more favored than the previously used James's formulas.[2]

• **The Risk of Error:** Because height is a critical variable in these formulas, any erroneous measurement-even by a few centimeters-can result in a falsely high or low SUL. This inaccuracy can lead to an incorrect inference regarding a patient's metabolic response during follow-up studies.

## Methodology & Repeat Audit

Following an initial audit conducted in 06.2025 that identified variations in height measurement, a repeat audit was conducted after a training program for Nuclear Medicine (NM) PET/CT technologists.

Audit Parameters:

• Sample Size: 150 patients undergoing follow-up PET/CT examinations from September 2025 to December 2025.

• Standardized Tool: Use of a stadiometer for height measurement to ensure accuracy and reproducibility. Technologists were trained in standardized procedures for heigh measurement (Fig.1).

• Comparative Analysis: Heights from baseline and follow-up studies were compared. Variations of >3 cm were flagged for clinical review to rule out physiological causes like vertebral collapse by reviewing sagittal spine view of PET/CT.

### The Importance of Technologist Training

The initial audit results underscored that "interval changes" in the technologist or nursing team can lead to significant data outliers-sometimes exceeding 10 cm-if standardized methods are not strictly followed. Training after a few months is crucial to maintain consistency and correct technique.

### Standardized Stadiometer Technique

To ensure accuracy, technologists were trained in the following standardized stadiometer protocol (Fig.1):

1. Preparation: Patients must remove shoes and any hair ornaments.

2. Positioning: The patient stands with heels together; the head, shoulders, buttocks, and heels must be in contact with the vertical surface.

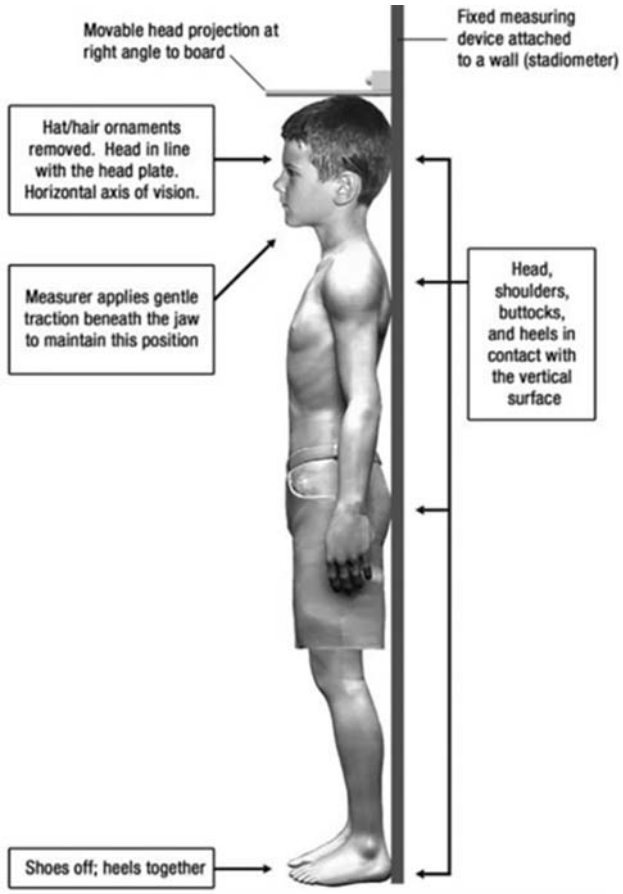


**Figure 1:** Standardized procedures for height measurement using a stadiometer.

3. Measurement: The movable head projection is brought down at a right angle to the board to record the height.

## Results

### Improved Accuracy and Clinical Implications

The post-intervention audit of 150 patients demonstrated a significant improvement in consistency of measurements (Tab.1). Key findings included:

• Reduced Deviation: There was a marked decrease in deviation from the baseline height measurement compared to the pre-training audit.

• Precision: Data points now concentrate within a 3 cm margin of error, significantly reducing the impact of "human variation".

• Elimination of Outliers: Extreme outliers of more than 10 cm, previously noted due to calibration errors or staff variation, were successfully addressed through the

| Variables (n=150) | Baseline | Follow-up | Difference in variables |
|---|---|---|---|
| Age in years (Mean +/- SD) | 54 ± 16 | | NA |
| Gender (Male: Female) | 80:70 | | NA |
| Duration between 02 studies (months) (Mean +/- SD) | 4.4 ± 1.2 | | NA |
| Height in cm (Mean +/- SD) | 163 ± 9 | 162.9 ± 8 | 0.23 ± 3.3 |

NA: not applicable

**Table 1:** Demographic data of patients

standardization process.

• The post-training Bland-Altman analysis of 150 patients demonstrated superior agreement with baseline measurements. The significant reduction in vertical scatter compared to pre-training data confirms that periodic technologist intervention effectively eliminates the 10 cm+ outliers previously caused by 'interval change' in staff and measurement technique (Fig.2a and 2b)

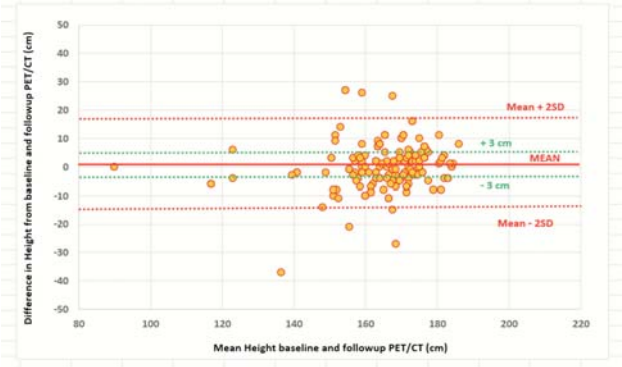


**Figure 2a:** Pre-intervention blond altman plot reveals that most of the data points are concentrated around the mean, plus or minus a 3 cm height difference, with a significant outlier of more than 10 cm due to non-standardized height measurement.

**Figure 2b:** Post-intervention Blond Altman Plot reveals that most of the data points are concentrated around the mean (± 3 cm) with a remarkable decrease in vertical scatter (outliers) compared with pre-intervention plot.

In follow-up FDG PET/CT, while weight may fluctuate due to therapy, height generally remains static. By achieving less deviation from the baseline, we ensure that changes in metabolic activity reflect actual biological responses rather than mathematical errors.

## Conclusion

The accuracy of PET/CT response assessment is greatly dependent on precisely measured and correctly entered patient's and study related data. This repeat audit confirms that:

• Standardization is Key: Using a standardized protocol for height measurement with stadiometer in all 150 patients has successfully reduced significant measurement variations.

• Ongoing Education: Continuous training of technologists is essential. Periodic re-training every six months prevents "technique drift" and accounts for staff turnover.

• Clinical Verification: Any height change >3 cm should be verified against the sagittal view of the CT bone window to distinguish between measurement error and actual vertebral collapse.

By adopting a standardized approach in height measurement using stadiometer, the Nuclear Medicine department ensures that the PERCIST criteria remain a robust and reliable tool for oncological care in future.

**CONFLICT OF INTEREST:** None.

## References


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