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Authors
Mingels, Clemens
Caobelli, Federico
Alavi, Abass
et al.

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LETTER TO THE EDITOR

Total-body PET/CT or LAFOV PET/CT? Axial field-of-view clinical classification

Clemens Mingels[1,2] · Federico Caobelli[1] · Abass Alavi[3] · Christos Sachpekidis[4] · Meiyun Wang[5] · Hande Nalbant[2] · Austin R. Pantel[3] · Hongcheng Shi[6] · Axel Rominger[1] · Lorenzo Nardo[2]

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Dear Sir,

Since the commercial introduction of the first positron emission tomography (PET) scanner in 1978, major subsequent technical advancements have resulted in new scanner designs [1–3]. Conventional PET scanners cover a limited axial field-of-view (FOV; 15–35 cm); these scanners are referred to as short-axial field-of-view (SAFOV) [4]. Whole-body SAFOV PET imaging (from vertex to toes) can be acquired either with step-and-shoot or continuous bed motion (CBM) techniques. SAFOV scanners are characterized by less efficient signal collection because roughly 85–90% of the body is usually outside the standard-axial FOV [5]. Moreover, for the tissues and organs in the scanner's FOV, only 3–5% of the available signal is collected [5]. To extend a scanner's FOV to capture more signal, several different approaches have been advanced. The first attempt of extending the axial FOV resulted in two non-commercially available PET prototypes at the beginning of this millennium, which were characterized by a FOV of > 50 cm [6, 7]. However, this coverage was not sufficient for imaging the clinically relevant area typically scanned in oncology in a single-bed position, and these instruments had limited technical capability not designed for routine clinical imaging.

The most common indication for PET/CT is oncological imaging, typically covering the area from skull base to mid thighs to capture potential sites of disease. The coverage form skull base to mid thighs is not sufficient to be classified as whole-body imaging. Therefore whole-body (WB) PET-imaging should only be used in scans, which show all body parts (vertex to toes). A WB PET-image can be obtained by with any PET-scanner either in step-and-shot, continuous bed motion, or in single bed position.

The average male heights reported for 2019 were 176.9 cm, 175.0 cm, and 175.7 cm for the USA, Europe, and China, respectively. In these countries, the average female heights in 2019 were 163.3 cm, 165.0 cm, and 163.5 cm, respectively. Hence, vertex to proximal thighs imaging would be possible for 95% of the population in a single bed position with an axial FOV of > 100 cm [8, 9]. Systems with a FOV greater than 100 cm were initially introduced by the University of Pennsylvania, Pennsylvania, USA, with the PennPET Explorer (Philips Technology) covering 142 cm [10, 11] and in Bern, Switzerland, with the Biograph Vision Quadra (Siemens Healthineers) with 106 cm FOV, while they are now used in more centers worldwide [4, 12–14]. In addition, the recently introduced Panorama GS (United Imaging Healthcare) with 148 cm FOV and the upcoming extension of the 32 cm OMNI Legend (GE Healthcare) with up to 128 cm FOV are going to be implemented into the clinic [15]. These devices with a FOV > 100 cm are referred to as long-axial FOV PET-systems (LAFOV) [4, 16, 17]. This coverage is sufficient to complete most of the oncologic and non-oncologic studies (e.g., lung cancer, lymphoma, vasculitis), since most PET-centres do not include the distal extremities in the scan [18]. We note that there is

✉ Clemens Mingels
clemens.mingels@insel.ch

1 Department of Nuclear Medicine, Inselspital, University Hospital Bern, University of Bern, Freiburgstr. 18, 3010 Bern, Switzerland

2 Department of Radiology, University of California Davis, Sacramento, CA, USA

3 Department of Radiology, Perelman School of Medicine, University of Pennsylvania, Philadelphia, PA, USA

4 Clinical Cooperation Unit Nuclear Medicine, German Cancer Research Centre, Heidelberg, Germany

5 Medical Imaging Institute, Henan Provincial People's Hospital & People's Hospital of Zhengzhou, Zhengzhou, China

6 Department of Nuclear Medicine, Zhongshan Hospital Fudan University, Shanghai, China

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an opportunity for scanners to have an extended axial FOV between a SAFOV and a LAFOV (> 35 cm but < 100 cm), capturing some, but not all, organs at peak sensitivity in a single FOV, or requiring several bed positions that would offer an attractive combination of performance and cost.

Clinical indications requiring a WB scan (e.g., melanoma, multiple myeloma, cancer of unknown primary, osteosarcoma, and other soft tissue malignancies), a minority of clinical scans, could be scanned successfully with a single-bed position in most of the population (95%) with an axial FOV greater than 188 cm [19]. However, the only clinically approved scanner in USA, European Union, Asia, and Australia with this specification is the uExplorer (United Imaging Healthcare), which was installed at UC Davis, CA, in 2019. This scanner has a FOV of 194 cm and is, therefore, not only a LAFOV, but also the only one that can be considered a total-body (TB) PET-scanner [20–22].

As there is still some confusion on the nomenclature with regard to different axial FOV, given the current commercially available scanners and the expected increase in the market for LAFOV machines [23], we believe that a precise clinical definition of the different scanner types based on their FOV should be proposed (Fig. 1 and Table 1).

In details:

- *Short-axial field-of-view* (SAFOV) PET-scanner: any scanner that needs more than one bed position to scan most of the population from vertex to thighs
- *Long-axial field-of-view* (LAFOV) PET-scanner: any scanner that can image vertex to thighs in most of the population in a single-bed position

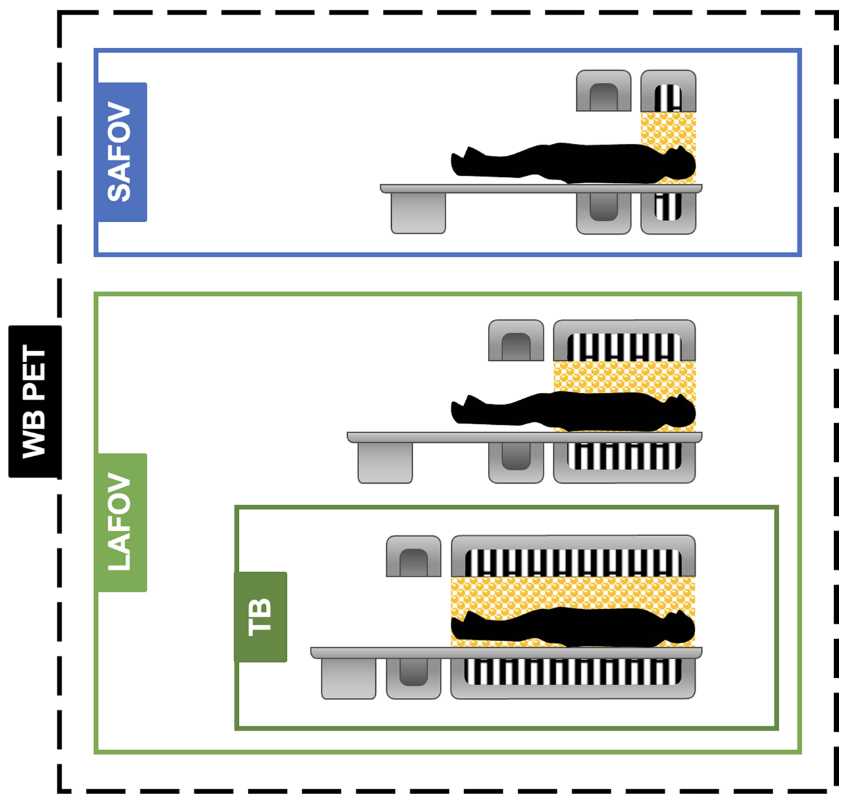

Fig. 1 Graphical representation of different PET/CT scanners based on axial field-of-view clinical classification. WB, whole-body imaging; SAFOV, short-axial field-of-view; LAFOV, long-axial field-of-view; TB, total-body

Table 1 Clinical definition of PET/CT scanners based on the axial field of view and their clinical implications

Coverage	Terminology	Abbreviation	Field-of-view (FOV)
PET-system covering a limited axial field-of-view *(in a single bed position)*	Short-axial field-of-view PET	SAFOV	< 35 cm
PET-system covering skull base to mid thighs *(in a single bed position)*	Long-axial field-of-view PET	LAFOV	> 100 cm
PET-system covering vertex to toes *(in a single bed position)*	Total-body PET	TB	> 188 cm

- *Total-body* (TB) PET-scanner: LAFOV scanner that can scan vertex to toes (WB PET-image) in most of the population in a single bed position

This classification should improve clarity in papers investigating the performance of the relevant scanners. Furthermore, it is warranted that this precise classification is more practically used in the routine clinical activity.

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