

1	Status	Sep 2016 Voting Packet
2	Date of Last Update	2016/05/25
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5	Submitter Name	QIBA FDG-PET group
6	Submission Date	2015/10/01

7	Correction Number CP-1612
8	Log Summary: Clarify incorrect multiplier for male James SUV lean body mass formula
9	Name of Standard
10	PS3.16 (2016a+CP1535)
11	Rationale for Correction:
12	For the James formula (male), the value 128 was misquoted in an article as 120.
13	So, the SUVlbm(James) males should = $1.1 \times \text{Weight} - 128 \times \text{Weight squared} / \text{Height squared}$
14	However, a survey of different vendors reveals that some use 120 and some use 128.
15	It is proposed that the existing definitions in DICOM be relaxed to allow for both possibilities, given that vendors may have implemented
16	it either way, and that a new code be added for the "correct" (128) value.
17	Correction Wording:

Amend PS 3.3:

C.8.9.1 PET Series Module

Table C.8-60. PET Series Module Attributes

Attribute Name	Tag	Type	Attribute Description
...
SUV Type	(0054,1006)	3	Type of Standardized Uptake Value (SUV). Enumerated Values: BSA body surface area BW body weight LBM lean body mass by James method (see Note) <u>LBMJAMES128</u> <u>lean body mass by James method using a multiplier of 128 for males</u> LBMJANMA lean body mass by Janmahasatian method IBW ideal body weight If absent, and the Units (0054,1001) are GML, then the type of SUV shall be assumed to be BW. Note The type of SUV cannot reliably be deduced from the units alone, i.e., SUVbw, SUVibw and SUVlbn (James or Janmahasatian) all have units of GML.
...

Note

The formulas for the determination of SUVbw, SUVbsa, SUVlbn(James) and SUVibw are defined in Sugawara et al. *Reevaluation of the Standardized Uptake Value for FDG: Variations with Body Weight and Methods for Correction. Radiology, 1999* at <http://radiology.rsna.org/content/213/2/521>.

Unfortunately, Sugawara used a parameter of 120 rather than 128 for males, propagating an error in Morgan DJ, Bray KM. Lean Body Mass as a Predictor of Drug Dosage: Implications for Drug Therapy. Clinical Pharmacokinetics. 1994;26(4):292–307, which misquoted the original LBM definition that used 128 in James WPT, Waterlow JC. Research on Obesity: A Report of the DHSS/MRC Group. London: Her Majesty's Stationery Office; 1976. Implementations differ in whether they have used 120 or 128 when the DICOM Defined Term is LBM. See Kelly M. SUV: Advancing Comparability and Accuracy. Siemens; 2009. Available from: http://www.mpcphysics.com/documents/SUV_White-paper_Final_11.17.09_59807428_2.pdf.

The Janmahasatian LBM formula is defined in *Janmahasatian et al. Quantification of Lean Bodyweight. Clin Pharmacokinet. 2005 Oct 1;44(10):1051–65.* at <http://dx.doi.org/10.2165/00003088-200544100-00004> and its role in SUVlbn(Janma) calculation is discussed in *Tahari et al. Optimum Lean Body Formulation for Correction of Standardized Uptake Value in PET Imaging. Journal of Nuclear Medicine. 2014 Sep 1;55(9):1481–4.* at <http://jnm.snmjournals.org/content/55/9/1481>.

See also

Amend DICOM PS 3.16:

CID 85 SUV Units

Type: Extensible
Version: 20160314yyyymmdd

Table CID 85. SUV Units

Coding Scheme Designator	Code Value	Code Meaning
UCUM	{SUVl _{bm} }g/ml{SUVl _{bm} }	Standardized Uptake Value lean body mass (James)
<u>UCUM</u>	<u>g/ml{SUVl_{bm}(James128)}</u>	<u>Standardized Uptake Value lean body mass (James 128 multiplier)</u>

Note

The formulas for the determination of SUV_{bw}, SUV_{bsa}, SUV_{l_{bm}}(James) and SUV_{v_{bw}} are defined in Sugawara et al. *Reevaluation of the Standardized Uptake Value for FDG: Variations with Body Weight and Methods for Correction*. *Radiology*, 1999 at <http://radiology.rsna.org/content/213/2/521>.

Unfortunately, Sugawara used a parameter of 120 rather than 128 for males, propagating an error in Morgan DJ, Bray KM. Lean Body Mass as a Predictor of Drug Dosage: Implications for Drug Therapy. *Clinical Pharmacokinetics*. 1994;26(4):292–307, which misquoted the original LBM definition that used 128 in James WPT, Waterlow JC. *Research on Obesity: A Report of the DHSS/MRC Group*. London: Her Majesty's Stationery Office; 1976. Implementations differ in whether they have used 120 or 128 for ({SUVl_{bm}}g/ml{SUVl_{bm}}, UCUM, "Standardized Uptake Value lean body mass (James)"). See Kelly M. SUV: Advancing Comparability and Accuracy. Siemens; 2009. Available from: http://www.mpcphysics.com/documents/SUV_Whitepaper_Final_11.17.09_59807428_2.pdf.

The Janmahasatian LBM formula is defined in Janmahasatian et al. *Quantification of Lean Bodyweight*. *Clin Pharmacokinet*. 2005 Oct 1;44(10):1051–65. at <http://dx.doi.org/10.2165/00003088-200544100-00004> and its role in SUV_{l_{bm}}(Janma) calculation is discussed in Tahari et al. *Optimum Lean Body Formulation for Correction of Standardized Uptake Value in PET Imaging*. *Journal of Nuclear Medicine*. 2014 Sep 1;55(9):1481–4. at <http://jnm.snmjournals.org/content/55/9/1481>.

The patient size correction factors are summarized here, where weight is in kg and height is in cm:

SUV_{bw}: males & females: weight

SUV_{l_{bm}}(James): males: $1.10 * \text{weight} - (120_{\text{or } 128}) * (\text{weight}/\text{height})^2$

females: $1.07 * \text{weight} - 148 * (\text{weight}/\text{height})^2$

SUV_{l_{bm}}(Janma): males: $9.27E3 * \text{weight} / (6.68E3 + 216 * \text{weight} / (\text{height}^2))$

females: $9.27E3 * \text{weight} / (8.78E3 + 244 * \text{weight} / (\text{height}^2))$

SUV_{bsa}: males & females: $\text{weight}^{0.425} * \text{height}^{0.725} * 0.007184$

SUV_{v_{bw}}: males: $48.0 + 1.06 * (\text{height} - 152)$

females: $45.5 + 0.91 * (\text{height} - 152)$

CID 7180 Abstract Multi-dimensional Image Model Component Semantics

Type: Extensible
Version: 20160314yyyymmdd

Table CID 7180. Abstract Multi-dimensional Image Model Component Semantics

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
...		

Coding Scheme Designator	Code Value	Code Meaning	SNOMED-CT Concept ID	UMLS Concept Unique ID
DCM	126402	SUVlbm		
DCM	ddd001	SUVlbm(James128)		

Amend DICOM PS3.16 concept definitions:

Table D-1. DICOM Controlled Terminology Definitions

Code Value	Code Meaning	Definition	Notes
126402	SUVlbm	Standardized Uptake Value calculated using lean body mass by James method. The patient size correction factor for males is $1.10 * \text{weight} - (120 \text{ or } 128) * (\text{weight}/\text{height})^2$, and for females is $1.07 * \text{weight} - 148 * (\text{weight}/\text{height})^2$. Defined in Sugawara et al. <i>Reevaluation of the Standardized Uptake Value for FDG: Variations with Body Weight and Methods for Correction</i> . Radiology, 1999 at http://radiology.rsna.org/content/213/2/521 , except that either 120 or 128 may be used as the multiplier parameter for males . Unfortunately, Sugawara used a parameter of 120 rather than 128, propagating an error in Morgan DJ, Bray KM. Lean Body Mass as a Predictor of Drug Dosage: Implications for Drug Therapy. Clinical Pharmacokinetics. 1994;26(4):292–307, which misquoted the original LBM definition that used 128 in James WPT, Waterlow JC. Research on Obesity: A Report of the DHSS/MRC Group. London: Her Majesty's Stationery Office; 1976. Implementations differ in whether they have used 120 or 128 when using this code. See Kelly M. SUV: Advancing Comparability and Accuracy. Siemens; 2009. Available from: http://www.mpcphysics.com/documents/SUV_Whitepaper_Final_11.17.09_59807428_2.pdf.	
ddd001	SUVlbm(James128)	Standardized Uptake Value calculated using lean body mass by James method, using the originally published 128 multiplier for males. The patient size correction factor for males is $1.10 * \text{weight} - 128) * (\text{weight}/\text{height})^2$, and for females is $1.07 * \text{weight} - 148 * (\text{weight}/\text{height})^2$.	
126411	SUV lean body mass calculation method	James method of calculating Standardized Uptake Value using lean body mass. The patient size correction factor for males is $1.10 * \text{weight} - (120 \text{ or } 128) * (\text{weight}/\text{height})^2$, and for females is $1.07 * \text{weight} - 148 * (\text{weight}/\text{height})^2$. Defined in Sugawara et al. <i>Reevaluation of the Standardized Uptake Value for FDG: Variations with Body Weight and Methods for Correction</i> . Radiology, 1999 at http://radiology.rsna.org/content/213/2/521 , except that either 120 or 128 may be used as the multiplier parameter for males . Unfortunately, Sugawara used a parameter of 120 rather than 128, propagating an error in Morgan DJ, Bray KM. Lean Body Mass as a Predictor of Drug Dosage: Implications for Drug Therapy. Clinical Pharmacokinetics. 1994;26(4):292–307, which misquoted the original LBM definition that used 128 in James WPT, Waterlow JC. Research on Obesity: A Report of the DHSS/MRC Group. London: Her Majesty's Stationery Office; 1976. Implementations differ in whether they have used 120 or 128 when using this code. See Kelly M. SUV: Advancing Comparability and Accuracy. Siemens; 2009. Available from: http://www.mpcphysics.com/documents/SUV_Whitepaper_Final_11.17.09_59807428_2.pdf.	
ddd002	SUV lean body mass calculation method using 128 multiplier	James method of calculating Standardized Uptake Value using lean body mass with the originally published 128 multiplier for males. The patient size correction factor for males is $1.10 * \text{weight} - 128) * (\text{weight}/\text{height})^2$, and for females is $1.07 * \text{weight} - 148 * (\text{weight}/\text{height})^2$.	