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Finding Sensitive Parameters in Internal Dose Calculations for Radiopharmaceuticals Commonly Used in Clinical Nuclear Medicine

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Original Paper

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Finding Sensitive Parameters in Internal Dose Calculations for Radiopharmaceuticals Commonly Used in Clinical Nuclear Medicine

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Key Words: uncertainty and sensitivity analysis; internal dosimetry; pharmacokinetic model; voxel phantom; nuclear medicine.

Abstract Internal dosimetry after incorporation of radionuclides requires standardized biokinetic and dosimetric models. The aim of the present work was to identify the parameters and the components of the models which contribute most to dosimetric uncertainty. For this a method was developed allowing for the calculation of the uncertainties of the absorbed dose coefficients. More specifically, the sampling-based regression method and the variance-based method were used to develop and apply a global method of sensitivity analysis. This method was then used to quantify the impact of various biokinetic and dosimetric parameters on the uncertainty of internal doses associated with the incorporation of seven common radiopharmaceuticals. It turned out that the correlation between biokinetic parameters and time-integrated activity or calculated absorbed dose is strongest when the source and target organ are identical, in accordance with the ICRP and the MIRD approach. According to the ICRP approach, the parameter F_S which describes the fractional distribution of any incorporated radioactivity to organ S, has the greatest correlation with the time-integrated activity in the corresponding source organ or with the calculated dose in the corresponding target organ. In contrast, the MIRD approach suggested several biokinetic parameters with similar correlation. The dosimetric parameters usually contribute more to uncertainty in the calculated dose coefficients than the biokinetic parameters, in both approaches. The results obtained are helpful for the revision of biokinetic models for radiopharmaceuticals, because the most important parameters in clinical applications can now be identified and investigated in future studies.

Introduction

The International Commission on Radiological Protection (ICRP) and the Committee on Medical Internal Radiation Dose (MIRD) provide a generalized approach for the calculation of absorbed dose and effective dose coefficients after administration of radiopharmaceuticals. In this approach, absorbed dose depends on a biokinetic model (Berman 1976) that describes time-dependent activity in organs, and on a dosimetric model (ICRP 2009) which is the mathematical representation of the human body (now voxel phantoms). The biokinetic and dosimetric models are described by biokinetic parameters and so-called S values, respectively.

Because of the uncertainty in the biokinetic parameters (investigated in various studies) and the uncertainty in the S values (derived from different phantoms (Cristy and Eckerman 1987; Snyder et al. 1978; Snyder et al. 1969; Snyder et al. 1975; Zankl et al. 2012; Zubal et al. 1994)), the resulting dose and effective dose coefficients are also uncertain (Stabin 2008b; Stabin 2008a; NCRP 2009). The aim of the present work was to investigate those biokinetic and dosimetric parameters most influential in terms of overall uncertainty of dose coefficients. These parameters should then be better investigated in future studies in an effort to further reduce the uncertainty of internal dose calculations. Furthermore, by exclusion of those parameters which have less influence on the overall uncertainty, the calculation effort can be minimized.

Based on the results of the uncertainty analysis from the first part of the study (Spielmann et al. 2016), in the present work the partial rank correlation coefficients between the biokinetic parameters and the calculated dose coefficients and also between the biokinetic parameters and the time-integrated activity in the source organs and tissues were determined for seven commonly used radiopharmaceuticals.

Materials and methods

Radiopharmaceuticals considered

In this study, the sensitivity of biokinetic and dosimetric parameters are calculated for the following commonly used radiopharmaceuticals: ^{18}F-FDG (Hays and Segall 1998; Brownell et al. 1980; Deloar et al. 1998; Reivich et al. 1979; Khamwan et al. 2010), ^{99m}Tc-pertechnetate (ICRP 1987; Andros et al. 1965; McAfee et al. 1964), ^{99m}Tc-phosphonate (ICRP 1987; Subramanian et al. 1975), ^{99m}Tc-sestamibi (ICRP 1998; Leide et al. 1992; Higley et al. 1993), ^{99m}Tc-tetrofosmin (ICRP 1998; Higley et al. 1993), ^{99m}Tc-macroaggregated albumin (MAA) (ICRP 1987) and ^{201}Tl-chloride (ICRP 2008; Atkins et al. 1977; Lebowitz et al. 1975; Krahwinkel et al. 1988; Castronovo 1993; Thomas et al. 2005).

Determination of Absorbed Dose Coefficients

The dose after incorporation of a radioactive substance can be calculated using the generalized approach for radiopharmaceutical dosimetry recommended by the MIRD Committee and ICRP (Bolch et al. 2009).

$$D(r_T, T_D) = \sum_{r_S} \tilde{A}(r_S, T_D) S(r_T \leftarrow r_S) \qquad \text{(Eq. 1)}$$

where $\tilde{A}(r_S, T_D)$ is the time-integrated activity in a source organ or region r_S over the integration period T_D, where T_D is commonly taken to be infinity (Bolch et al. 2009); $S(r_T \leftarrow r_S)$ is a radionuclide-specific quantity representing the mean absorbed dose to target tissue r_T per unit activity in source tissue r_S, the so-called S value, and D is the absorbed dose in a target organ from all source organs.

There are two approaches to calculate the time-integrated activity in a tissue or organ, namely the compartmental modeling method proposed by the MIRD Committee and the analytical method proposed by ICRP.

Determination of the Time-integrated Activity According to the MIRD Approach

The time-integrated activity in a source organ can be calculated as (Eq. 2):

$$\tilde{A} = \int_0^{T_D} q(t)\, dt \qquad \text{(Eq. 2)}$$

Where $q(t)[Bq]$ is the activity of the radioactive substance in an organ at time t. It can be obtained from the solution of a system of ordinary linear differential equations (Berman 1976;1-14). For example, the biokinetic model parameters for radiopharmaceutical FDG, reported by (Hays and Segall 1998; Reivich et al. 1979; Huang et al. 1980), were used in the present work for the uncertainty analysis of the time-integrated activity (Spielmann et al. 2016).

Determination of the Time-integrated Activity According to the ICRP Approach

To calculate the time-integrated activity, ICRP express the transfer rates used in their biokinetic models in terms of fractions and half-lives. In contrast to the MIRD approach, the time-integrated activity can be calculated here explicitly as follows (Eq. 3) (ICRP 1987):

$$\frac{\tilde{A}_S}{A_0} = F_S \sum_{j=n+1}^{n+m} a_j \sum_{i=1}^{n} \left[a_i \frac{T_i}{T_i - T_j} \left(\frac{T_{i,eff}}{\ln 2} - \frac{T_{j,eff}}{\ln 2} \right) \right] \qquad \text{(Eq. 3)}$$

Where A_0 is the administered activity, F_S is the fractional distribution to organ S, a_i is a fraction of the parameter F_S eliminated with a biological half-life T_i from the compartment i, a_j is the fraction of F_S taken up with a biological half-life T_j in the compartment j, n is the number of elimination components, m is the number of uptake components. For the biokinetic parameters F_S, a_i and a_j Eq. 4 applies:

$$\sum F_S = 1, \sum a_i = 1 \text{ and } \sum a_j = 1 \qquad \text{(Eq. 4)}$$

$T_{i,eff}$ and $T_{j,eff}$ are the elimination and uptake effective half-lives, respectively. The effective half-life can be calculated from the corresponding biological half-life T_i and the physical half-life T_p:

$$\frac{1}{T_{i,eff}} = \frac{1}{T_p} + \frac{1}{T_i} \qquad \text{(Eq. 5)}$$

For many widely used radiopharmaceuticals the corresponding biokinetic parameters F_s, a_i, a_j, T_i and T_j are reported in ICRP publications (ICRP 1987, 1998, 2008, 2015).

Sensitivity indices

For quantification of the sensitivity of the parameters used in the mathematical model (Eq. 1) two methods were used here - the sampling-based regression method and the variance-based method. In the sampling-based regression method the relationships between the biokinetic model parameters, the time-integrated activity in the source organ, and the absorbed dose in the target organ, are investigated. According to Eqs. 1 and 3, and Eq. 3 in (Spielmann et al. 2016) and assuming that all S values remain constant, the degree of the relationship between the model parameters and the absorbed dose, and the degree between the model parameters and the time-integrated activity were calculated. As a measure for this relationship, the partial rank correlation coefficient was applied as a sensitivity index. Additionally, the model-free variance-based method was applied to calculate the contribution of the dosimetric and biokinetic parameters to the absorbed dose coefficients. For the quantification of the importance or the influence of each model parameter and S value, the total-effect index was used as a sensitivity measure.

Determination of the Partial Rank Correlation Coefficients

The partial rank correlation coefficients between the biokinetic parameters and the time-integrated activity were determined by means of a software tool which was modified from a code originally developed by Iman et al. (Iman et al. 1985). The following steps were carried out.

A mathematical biokinetic model is characterized by k biokinetic parameters $X_1, X_2, \dots, X_k$. Here it was assumed that the parameters were normally distributed. By means of the Latin Hypercube Sampling (LHS) method (Iman and Shortencarier 1984) $n = 500$ samples for each parameter were calculated.

By using the Eq. 3 and Eq. 3 in (Spielmann et al. 2016), 500 values for time-integrated activity were calculated.

The sample correlation coefficient r_{ij} between parameters X_i and X_j and the sample correlation coefficient r_{yj} between parameters X_j and the time-integrated activity Y were calculated. These coefficients form a correlation matrix C.

$$C = \begin{bmatrix} 1 & r_{12} & \dots & r_{1k} & r_{1y} \\ r_{21} & 1 & \dots & r_{2k} & r_{2y} \\ r_{k1} & r_{k2} & \dots & 1 & r_{ky} \\ r_{y1} & r_{y2} & \dots & r_{yk} & 1 \end{bmatrix} \quad \text{(Eq. 6)}$$

with

$$r_{xy} = \frac{\sum_{i=1}^{n}(x_i-\bar{x})(y_i-\bar{y})}{\sqrt{\sum_{i=1}^{n}(x_i-\bar{x})^2 \sum_{i=1}^{n}(y_i-\bar{y})^2}} \quad \text{(Eq. 7)}$$

For the inverted matrix C^{-1} holds:

$$C^{-1} = \begin{bmatrix} \frac{1}{1-R_{x_1}^2} & c_{12} & \dots & c_{1k} & -\frac{B_1}{1-R_y^2} \\ c_{21} & \frac{1}{1-R_{x_2}^2} & \dots & c_{2k} & -\frac{B_2}{1-R_y^2} \\ \dots & \dots & \dots & \dots & \dots \\ c_{k1} & c_{k2} & \dots & \frac{1}{1-R_{x_k}^2} & -\frac{B_k}{1-R_y^2} \\ -\frac{B_1}{1-R_y^2} & -\frac{B_2}{1-R_y^2} & \dots & -\frac{B_k}{1-R_y^2} & -\frac{1}{1-R_y^2} \end{bmatrix} \quad \text{(Eq. 8)}$$

with

$$P_{x_j y} = B_j \sqrt{\frac{1-R_{x_j}^2}{1-R_y^2}} \quad \text{(Eq. 9)}$$

Where $P_{x_j y}$ are the partial correlation coefficients between model parameters and time-integrated activity.

B_j is the standardized regression coefficient for X_j, and $R_{x_j}^2$ and R_y^2 are coefficients of determination corresponding to regressing X_j on Y and the remaining X's; $R_{x_j}^2 = 0.92$ means, for example, that 92% of the variations of all Y's can be explained by X_j.

Because of Eq. 4 some of the parameters are directly dependent on each other. This dependence causes the determinant of matrix C to become 0, and the matrix cannot be inverted accordingly. For this reason, some parameters were excluded from the calculation. For example, parameters like "Others Fs" and "Others ai3" of ^{18}F-FDG are therefore excluded from Supplemental Table 2.

The calculation of the partial rank correlation coefficients between the biokinetic parameters and the absorbed dose coefficients was performed in the same procedure.

Determination of the Total-Effect Indices

Equation 1 shows that the uncertainty of the absorbed dose can be attributed to the uncertainty in the time-integrated activity which depends on the biokinetic parameters, and the uncertainty in the S values. In the present work the methods developed by Sobol (Sobol 1990, 1993, 1969) and Saltelli (Saltelli et al. 2000; Saltelli et al. 2004; Saltelli et al. 2008) were applied, to quantify the contribution of the biokinetic parameters and the S values to the uncertainty of the internal dose in the target organ.

Let Y be a function that depends on variables $X_1, X_2, \dots, X_k$, then the sensitivity of the variables can be expressed by the relation:

$$S_i = \frac{V_{X_i}\left(E_{\boldsymbol{X}_{\sim i}}(Y|X_i)\right)}{V(Y)} \qquad \text{(Eq. 10)}$$

Where $\boldsymbol{X}_{\sim i}$ means all variables but X_i, and $E_{\boldsymbol{X}_{\sim i}}(Y|X_i)$ is the expected value of Y by keeping X_i fixed while averaging over all variables but X_i. $V(Y)$ denotes the variance of Y.

S_i is known as the first-order sensitivity index of X_i on Y. This index does not consider interactions of the variable X_i with other variables. The interaction between two variables can be written as

$$\frac{V\left(E\left(Y|X_i, X_j\right)\right)}{V(Y)} = S_{X_i} + S_{X_j} + S_{X_i,X_j} \qquad \text{(Eq. 11)}$$

Where S_{X_i,X_j} or S_{ij} indicates the second-order sensitivity index.

To quantify the sensitivity of a variable X_i together with all its interactions with other variables, the total effect S_{Ti} of the variable can be defined:

$$S_{Ti} = \frac{E_{\boldsymbol{X}_{\sim i}}\left(V_{X_i}(Y|X_{\sim i})\right)}{V(Y)} = 1 - \frac{V_{\boldsymbol{X}_{\sim i}}\left(E_{X_i}(Y|\boldsymbol{X}_{\sim i})\right)}{V(Y)} \qquad \text{(Eq. 12)}$$

Because of interaction terms, the sum of total-effects of the parameters can be greater than 1 for a non-additive model.

Equations 1 and 3 together with Eq. 3 in (Spielmann et al. 2016) represent the mathematical model to calculate absorbed dose as a function of Y from k variables. In that case, $1, 2, \ldots, n$ variables represent the biokinetic parameters, and $n+1, n+2, \ldots, k$ variables represent the S values.

The Monte-Carlo based numerical procedure for computing the set of total-effect indices for a model of k variables, as described by Saltelli et al. (Saltelli et al. 2008) was implemented in the present work.

Using the LHS method, two independent matrices $\boldsymbol{A}$ and $\boldsymbol{B}$ of dimension (N, k) were generated. Here, N is the number of rows and represents samples. In the present case $N = 500$ samples for each matrix were generated. The k columns represent n biokinetic and $n+1, \ldots, k$ dosimetric parameters (S values). From each k-tuple (sequence of k elements) absorbed dose coefficients can be calculated, so that 500 absorbed dose coefficient values for each matrix were generated.

It can be shown that the expected value E required for the total-effect index and the variance V can be calculated from the following relationship (Saltelli et al. 2008):

$$E_{\boldsymbol{X}_{\sim i}}\left(V_{X_i}(Y|\boldsymbol{X}_{\sim i})\right) = \frac{1}{2N}\sum_{j=1}^{N}\left(f(\boldsymbol{A})_j - f\left(\boldsymbol{A}_{\boldsymbol{B}}^{i}\right)_j\right)^2 \qquad \text{(Eq. 13)}$$

$$V(Y) = \frac{1}{N}\sum_{j=1}^{N} f(\boldsymbol{A})_j{}^2 - f_0^2 \qquad \text{(Eq. 14)}$$

$$f_0^2 = \left(\frac{1}{N}\sum_{j=1}^{N} f(\boldsymbol{A})_j\right)^2 \qquad \text{(Eq. 15)}$$

Where $\boldsymbol{A}_{\boldsymbol{B}}^{i}$ represents the matrix $\boldsymbol{A}$, in which the i-th column has been replaced by the corresponding one of the matrix $\boldsymbol{B}$. $f(\boldsymbol{A})_j$ is the calculated absorbed dose of the j-th sample.

In the present study the total effect of all biokinetic parameters as a group together and all S values as another group were calculated. For this purpose columns $1, \ldots, n$ of matrices $\boldsymbol{A}$ and $\boldsymbol{B}$ were considered as one biokinetic parameter, and columns $n+1$ to k as one S value.

By means of the computer program DoseU which was developed at the Helmholtz Zentrum München (Spielmann et al. 2016), calculations were carried out for all seven radiopharmaceuticals according to the ICRP approach. For ^{18}F-FDG the calculation was additionally carried out according to the MIRD approach.

Moreover, the total effect S_{Ti} of each individual biokinetic parameter and selected S values for the radiopharmaceuticals ^{18}F-FDG and ^{99m}Tc-macroaggregated albumin were also calculated. For ^{18}F-FDG the S_{Ti} for biokinetic parameters was determined according to both approaches, ICRP and MIRD.

Results

In the main body of this paper, the most important results obtained for ^{18}F-FDG are shown (Tables 1-3), while the rest of the results obtained are summarized in Supplemental Tables.

Sampling-based sensitivity indices

Supplemental Table 1 shows the partial rank correlation coefficients between the biokinetic model parameters and the absorbed dose coefficients in the target organs for ^{18}F-FDG according to the MIRD approach.

The data for ^{18}F-FDG according to the ICRP approach, and those for the rest of the radiopharmaceuticals can be found in Supplemental Tables 2–8.

Supplemental Tables 9-16 show the partial rank correlation coefficients between the biokinetic model parameters and the time-integrated activity in the source organs.

The sensitivity indices range from -1 to 1, where 0 indicates no correlation and -1 and 1 indicate a strong negative and positive correlation, respectively.

Variance-based sensitivity indices

The results of the variance-based sensitivity analysis are shown in Tables 1-3 and in the Supplemental Tables 17–27. Tables 1-2 show the sensitivity indices for ^{18}F-FDG in terms of biokinetic parameters and S values, according to the MIRD and ICRP approach, respectively. As mentioned above, these indices quantify the contributions of biokinetic parameters and the S values to the uncertainty of the dose coefficients. The Supplemental Tables 17-22 show sensitivity indices for the rest of the radiopharmaceuticals calculated according to the ICRP approach. Additionally, the individual contributions of each biokinetic and dosimetric parameter to the uncertainty of absorbed dose coefficients for the radiopharmaceuticals ^{18}F-FDG and ^{99m}Tc-macroaggregated albumin were calculated.

The total-effect indices of biokinetic parameters and selected S values for the radiopharmaceutical ^{18}F-FDG calculated according to the MIRD approach are shown in Supplemental Table 23 and in Table 3, while those calculated according to the ICRP approach are shown in Supplemental Tables 24-25, respectively. Finally, Supplemental Tables 26-27 show the total-effect indices of each biokinetic parameter and selected S values for the radiopharmaceutical ^{99m}Tc-macroaggregated albumin calculated according to the ICRP approach.

Discussion

As expected, the greatest correlations between the biokinetic parameters and the calculated absorbed dose coefficients in the target organ or between the biokinetic parameters and the time-integrated activity in the source organ were always found when the source and target organ are the same. According to the MIRD approach, the transfer coefficient from plasma to liver shows, for instance, the greatest correlation with the time-integrated activity in the source organ "liver", with the partial ranking correlation coefficient (PRCC) of 0.95 (Supplemental Table 9). This parameter correlates also very strongly with the absorbed dose coefficient calculated for the target organ "liver", with a PRCC of 0.90 (Supplemental Table 1). Likewise, the transfer coefficient from plasma to lungs correlates very strongly with the source organ "lungs", with PRCC=0.96 (Supplemental Table 9), and with the dose coefficient in the target organ "lungs", with PRCC of 0.68 (Supplemental Table 1).

According to the ICRP approach, the biokinetic parameter F_s correlates most strongly with the calculated absorbed dose coefficient in the corresponding target organ (Supplemental Tables 2-8). Also, for the biokinetic parameter and time-integrated activity pair, the parameter F_s shows the greatest correlation with the time-integrated activity in the corresponding source organs (Supplemental Tables 10-16).

In Eq. 3 shown above, the dependence of the biokinetic parameters on each other is not as strong as suggested by the MIRD method (see Eq. 3 in (Spielmann et al. 2016)). For this reason, according to the MIRD approach one sometimes finds a strong correlation between the biokinetic parameters and the calculated absorbed dose coefficients (Supplemental Table 1), or between the biokinetic parameters and the time-integrated activity (Supplemental Table 9), even when the source and target organ are not the same.

Tables 1-2 and Supplemental Tables 17-22 show that for all radiopharmaceuticals other than ^{201}Tl-chloride, the S values usually indicate a greater contribution to the uncertainty of internal dose than the biokinetic parameters. The sensitivity indices of the model parameters show a high value only for the target organs which are simultaneously the source organs,

and for some of them the value exceeds that of the S values. For instance, for ^{18}F-FDG the source organs are brain, heart wall, lungs and liver (ICRP 2008), the values of the total-effect indices for these organs and tissues are quite high, i.e., greater than 38 %, and the values of the liver and heart wall (51.0 % and 54.7 %, respectively) exceed the values of the S values (47.7 % and 44.0 %, respectively) (Table 2).

For ^{18}F-FDG the contributions of each biokinetic parameter and S value according to the ICRP approach can be found in the Supplemental Tables 24-25. The highest contribution to uncertainty is from the model parameter F_S and almost always for the corresponding target organ. Similarly, if the target organs are also the source, the contribution of the S values to the uncertainty in the dose in target organs is the highest. For instance, for the target organ "liver" the contribution of the parameter F_S to dose uncertainty is 52.3 % for the source organ "liver", 0.1 % for the source organ "lungs" and 0.2 % for the source organ "ht-wall" (Supplemental Table 24). Likewise, the contribution of the S value to dose uncertainty in the target organ "liver" are 47.5 % for $S_{Liver\text{->}Liver}$ and 0.3 % for $S_{Others\text{->}Liver}$ (Supplemental Table 25). The fact that the parameter F_S correlates most strongly with absorbed dose coefficients in the corresponding target organ was also found when the sampling-based regression method was used.

Similarly, when the MIRD approach was used, the biokinetic parameters and S values have, generally, the greatest contribution to the dose uncertainty in target organs, if the target and the source organs are the same (Supplemental Table 23 and Table 3).

Although the biokinetic models used in the MIRD and ICRP approaches are quite different, the results obtained from the sensitivity analysis are comparable. Except for the organs "liver", "lymph" and "muscle", the S values usually show a greater contribution to the uncertainty of calculated absorbed dose coefficients than the biokinetic parameters, and the contribution of the biokinetic parameters of the source organs "brain" and "heart wall" to dose uncertainty are quiet high, more than 48 % (Table 1 and 2).

In the case of ^{99m}Tc-pertechnetate there is an early active uptake especially in the thyroid (ICRP 1987) and, accordingly, the sensitivity index of the biokinetic parameters for the thyroid as a target organ is 95%, and much higher than the sensitivity index of the S value (Supplemental Table 17).

For ^{99m}Tc-phosphonate, the sensitivity indices of the parameters exceed those of the S values for the salivary gland, ET and O-mucosa (Supplemental Table 18); for ^{99m}Tc-sestamibi this is the case for brain, liver, thyroid and the kidneys (Supplemental Table 19), while for ^{99m}Tc-tetrofosmin this is the case for the thyroid gland as target organ (Supplemental Table 20).

For ^{99m}Tc-MAA, all S values show larger sensitivity indices than the model parameters (Supplemental Table 21). In the case of ^{201}Tl chloride, more than two thirds of sensitivity indices for the model parameters are greater than those of the S values (Supplemental Table 22).

The fact that the sensitivity indices of the S values are generally higher than those of the biokinetic parameters means that the contribution of uncertainty of S values to uncertainty of absorbed dose coefficients is higher than that of the uncertainty of biokinetic parameters. Differences in organ size and distances between organs have a great influence on the uncertainty of the S values and, consequently, on the uncertainties in the determination of absorbed dose coefficients. Comparison of mathematical and voxel anthropomorphic phantoms has, for instance, shown that absorbed organ doses differ up to 200% depending on which phantom is used (Spielmann et al. 2016). For this reason, choosing a suitable phantom for calculating internal doses to a particular patient is essential.

The biokinetic model structure certainly also contributes to the uncertainty of dose in target organs; however, this was not analyzed in the present study.

It is emphasized that the present paper focuses on approaches of internal dosimetry jointly proposed by ICRP and MIRD. These approaches are generally recognized and authorized as standard approaches in nuclear

medicine dosimetry. Of course, the method presented in this paper can be also applied to alternative dosimetric approaches as, for example, the RADAR method, which was introduced by Stabin (Stabin 2007). This was, however, not the scope of the present study.

Conclusion

In this work, a general method for the quantitative determination of the sensitivity of biokinetic and dosimetric parameters to absorbed dose uncertainty was developed, for radiopharmaceuticals. The method was used for calculating sampling-based partial rank correlation coefficients between the biokinetic parameters, time-integrated activity and the absorbed dose coefficients of seven radiopharmaceuticals commonly used in nuclear medicine. Furthermore, the variance-based sensitivity indices for biokinetic parameters and selected S values for these radiopharmaceuticals were also calculated.

In general, the biokinetic parameters show the strongest correlation both with the calculated dose coefficients and the time-integrated activity when the source and the target organ are the same. According to the ICRP approach, the parameter F_S has the greatest influence on the variance of the internal dose.

It is concluded that the S values usually contribute more to the uncertainty of calculated absorbed dose coefficients than the biokinetic parameters. The results are helpful for the revision of biokinetic models for radiopharmaceuticals. In particular, based on the results obtained and the methods developed in the present study, the most important parameters in clinical applications can be identified and investigated in future studies. The final goal is to establish more realistic models and reduce the uncertainty in patient dose and risk estimation. In that process, application of the developed method to alternative dosimetric approaches, e.g. RADAR, is also an option.

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Tables

Table 1: Total-effect index for biokinetic parameters and S values for ^{18}F-FDG according to the MIRD approach

Target	Parameter	S value
Brain	55.8%	43.6%
Breast	20.0%	86.2%
Colon	8.0%	95.2%
Endosteum	15.5%	87.3%
Liver	15.8%	84.4%
Lungs	18.0%	81.9%
Oesophagus	42.5%	67.0%
Red marrow	32.8%	60.5%
Salivary glands	21.1%	86.6%
Skin	20.6%	80.7%
Stomach wall	14.9%	88.8%
Testes	31.8%	71.7%
Thyroid	27.8%	80.2%
Urinary bladder wall	14.4%	90.9%
Adrenals	21.3%	81.0%
Extrathoracic airways	31.7%	70.3%
Gall bladder wall	7.2%	91.9%
Heart wall	56.4%	48.2%
Kidneys	8.1%	87.6%
Lymph	75.0%	33.9%
Muscle	71.1%	35.1%
Oral mucosa	13.5%	88.3%
Pancreas	31.1%	68.2%
Prostate	37.4%	66.9%
Small intestine wall	11.0%	89.3%
Spleen	6.0%	99.2%
Thymus	30.2%	70.7%

Table 2: Total-effect index for biokinetic parameters and S values for ^{18}F-FDG according to the ICRP approach

Target	Parameter	S value
Brain	48.3%	50.4%
Breast	9.5%	92.6%
Colon	9.8%	91.5%
Endosteum	12.5%	97.4%
Liver	51.0%	47.7%
Lungs	38.3%	69.0%
Oesophagus	38.1%	55.0%
Red marrow	15.1%	86.0%
Salivary glands	13.2%	80.5%
Skin	15.5%	86.3%
Stomach wall	24.8%	71.9%
Testes	6.9%	98.1%
Thyroid	13.2%	88.5%
Urinary bladder wall	0.1%	100.8%
Adrenals	33.5%	67.1%
Extrathoracic airways	22.9%	82.1%
Gall bladder wall	40.1%	58.0%
Heart wall	54.7%	44.0%
Kidneys	18.5%	82.0%
Lymph	12.8%	92.4%
Muscle	12.5%	82.9%
Oral mucosa	9.0%	96.2%
Pancreas	20.5%	87.8%
Prostate	2.7%	100.6%
Small intestine wall	11.0%	91.8%
Spleen	28.9%	69.7%
Thymus	18.1%	88.3%

Table 3: Total-effect index for S values for ^{18}F-FDG according to the MIRD approach

Target	UB cont	Brain	Liver	Lungs	Heart	Blood	Others
Brain	0.0%	19.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Breast	0.0%	0.6%	0.2%	0.2%	2.1%	6.4%	63.4%
Colon	10.5%	0.0%	0.7%	0.0%	0.0%	11.3%	69.5%
Endosteum	1.1%	55.8%	0.1%	0.1%	0.0%	1.4%	49.2%
Liver	0.0%	0.0%	1.7%	0.0%	0.0%	1.2%	33.9%
Lungs	0.0%	0.0%	0.0%	10.6%	0.3%	8.7%	55.0%
Oesophagus	0.0%	0.4%	0.0%	0.0%	1.1%	9.3%	28.3%
Red marrow	1.2%	5.8%	0.1%	0.0%	0.1%	1.2%	75.8%
Salivary glands	0.0%	38.1%	0.0%	0.0%	0.0%	3.8%	65.4%
Skin	0.8%	4.5%	0.0%	0.0%	0.0%	1.3%	77.9%
Stomach wall	0.1%	0.0%	0.5%	0.0%	0.4%	13.6%	65.9%
Testes	2.6%	0.0%	0.0%	0.0%	0.0%	0.5%	43.4%
Thyroid	0.0%	2.1%	0.0%	0.1%	0.2%	16.4%	40.8%
Urinary bladder wall	61.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.3%
Adrenals	0.7%	0.0%	1.9%	0.0%	0.1%	14.3%	55.2%
Extrathoracic airways	0.0%	9.0%	0.0%	0.0%	0.0%	1.2%	30.5%
Gall bladder wall	0.3%	0.0%	1.6%	0.0%	0.1%	7.6%	71.9%
Heart wall	0.0%	0.0%	0.0%	0.0%	24.3%	0.3%	3.1%
Kidneys	8.8%	0.0%	0.5%	0.0%	0.0%	20.5%	65.9%
Lymph	2.8%	0.4%	0.1%	0.0%	0.0%	0.4%	9.7%
Muscle	0.3%	1.5%	0.0%	0.0%	0.0%	0.2%	22.0%
Oral mucosa	0.0%	74.6%	0.0%	0.0%	0.0%	0.0%	1.5%
Pancreas	0.4%	0.0%	1.9%	0.0%	0.1%	10.1%	49.6%
Prostate	10.7%	0.0%	0.0%	0.0%	0.0%	0.8%	23.8%
Small intestine wall	10.9%	0.0%	0.0%	0.0%	0.0%	12.4%	59.2%
Spleen	0.6%	0.0%	0.2%	0.0%	0.5%	36.2%	68.5%
Thymus	0.0%	0.7%	0.0%	0.2%	10.5%	7.6%	35.7%

UB cont – urinary bladder contents; Others – other tissue

Supplemental Data 1

TABLE 1

Partial rank correlation coefficient between biokinetic parameter and absorbed dose coefficient in the target organ for 18F-FDG according to the MIRD approach

Target	Plasma to RBC	RBC to Plasma	Plasma to Urine	Plasma to WMF	WMF to Plasma	WMF to WMS	WMS to WMF
Brain	-0.17	0.06	-0.11	0.46	-0.50	0.42	-0.18
Breast	0.44	-0.27	-0.35	-0.42	0.46	-0.37	0.16
Colon	-0.17	0.13	0.26	-0.43	0.46	-0.35	0.12
Endosteum	-0.50	0.31	-0.03	0.34	-0.47	0.40	-0.20
Liver	-0.06	0.04	-0.17	-0.25	0.29	-0.15	0.04
Lungs	0.19	-0.09	-0.36	-0.42	0.45	-0.38	0.19
Oesophagus	0.27	-0.15	-0.32	-0.40	0.44	-0.32	0.12
Red marrow	-0.16	0.12	0.12	-0.38	0.40	-0.27	0.07
Salivary glands	-0.45	0.24	-0.54	0.43	-0.53	0.45	-0.22
Skin	-0.17	0.12	-0.18	-0.33	0.34	-0.19	0.05
Stomach wall	0.34	-0.18	-0.32	-0.42	0.45	-0.36	0.15
Testes	-0.25	0.18	0.59	-0.43	0.46	-0.36	0.10
Thyroid	-0.09	0.06	-0.30	-0.36	0.37	-0.23	0.07
Urinary bladder wall	-0.20	0.14	0.92	-0.22	0.29	-0.29	0.04
Adrenals	-0.05	0.07	-0.26	-0.37	0.39	-0.29	0.12
Extrathoracic airways	-0.28	0.12	-0.28	0.46	-0.53	0.46	-0.20
Gall bladder wall	-0.10	0.10	-0.21	-0.28	0.29	-0.21	0.06
Heart wall	0.88	-0.76	-0.29	-0.34	0.38	-0.35	0.10
Kidneys	-0.12	0.10	-0.19	-0.39	0.41	-0.29	0.11
Lymph	0.27	-0.13	0.38	-0.49	0.52	-0.44	0.17
Muscle	-0.07	0.07	0.20	-0.44	0.46	-0.34	0.11
Oral mucosa	-0.19	0.07	-0.19	0.45	-0.51	0.43	-0.19
Pancreas	-0.03	0.05	-0.26	-0.39	0.41	-0.29	0.12
Prostate	-0.28	0.19	0.93	-0.32	0.43	-0.40	0.07
Small intestine wall	-0.16	0.12	0.13	-0.41	0.44	-0.32	0.11
Spleen	0.03	0.00	-0.26	-0.39	0.42	-0.28	0.09
Thymus	0.37	-0.23	-0.32	-0.39	0.45	-0.33	0.12

Target	Plasma to GMF	GMF to Plasma	GMF to GMS	GMS to GMF	Plasma to Fast OT	Fast OT to Plasma
Brain	0.75	-0.82	0.60	-0.26	-0.81	0.75
Breast	-0.69	0.78	-0.57	0.21	0.85	-0.78
Colon	-0.68	0.78	-0.54	0.22	0.88	-0.83
Endosteum	0.71	-0.79	0.56	-0.27	0.07	-0.03
Liver	-0.50	0.54	-0.34	0.17	0.50	-0.47
Lungs	-0.69	0.78	-0.56	0.21	0.81	-0.72

Oesophagus	-0.65	0.76	-0.54	0.17	0.88	-0.83
Red marrow	-0.58	0.70	-0.46	0.16	0.89	-0.85
Salivary glands	0.78	-0.85	0.63	-0.36	0.11	-0.03
Skin	-0.48	0.62	-0.40	0.12	0.91	-0.87
Stomach wall	-0.68	0.77	-0.55	0.21	0.85	-0.80
Testes	-0.68	0.78	-0.53	0.20	0.84	-0.79
Thyroid	-0.56	0.68	-0.45	0.14	0.91	-0.86
Urinary bladder wall	-0.48	0.59	-0.37	0.20	-0.80	0.74
Adrenals	-0.62	0.71	-0.47	0.21	0.88	-0.83
Extrathoracic airways	0.77	-0.84	0.62	-0.31	-0.66	0.61
Gall bladder wall	-0.55	0.62	-0.39	0.20	0.75	-0.70
Heart wall	-0.56	0.70	-0.47	0.18	-0.75	0.67
Kidneys	-0.63	0.73	-0.49	0.20	0.90	-0.86
Lymph	-0.76	0.83	-0.62	0.27	0.80	-0.74
Muscle	-0.68	0.77	-0.54	0.21	0.88	-0.83
Oral mucosa	0.76	-0.83	0.61	-0.28	-0.76	0.70
Pancreas	-0.63	0.72	-0.49	0.21	0.89	-0.84
Prostate	-0.65	0.75	-0.51	0.24	-0.62	0.54
Small intestine wall	-0.66	0.76	-0.52	0.20	0.89	-0.85
Spleen	-0.62	0.73	-0.50	0.16	0.90	-0.85
Thymus	-0.66	0.76	-0.54	0.17	0.86	-0.81

Target	Fast OT to Slow OT	Plasma to Fast Liver	Fast Liver to Plasma	Fast Liver to Slow Liver	Plasma to Myocardium	Plasma to Lungs
Brain	-0.72	-0.15	0.08	-0.02	-0.19	0.00
Breast	0.76	0.03	-0.05	-0.10	-0.35	0.06
Colon	0.81	0.01	0.01	-0.07	-0.33	-0.12
Endosteum	0.01	-0.56	0.29	-0.33	-0.82	-0.08
Liver	0.44	0.90	-0.73	0.73	-0.21	-0.01
Lungs	0.72	-0.11	0.07	-0.20	-0.36	0.68
Oesophagus	0.80	-0.17	0.05	-0.18	-0.32	-0.03
Red marrow	0.82	-0.22	0.12	-0.22	-0.63	-0.04
Salivary glands	0.07	-0.52	0.26	-0.31	-0.60	-0.09
Skin	0.84	-0.19	0.08	-0.18	-0.64	-0.09
Stomach wall	0.77	0.20	-0.14	0.02	-0.30	-0.05
Testes	0.75	-0.33	0.22	-0.27	-0.36	-0.13
Thyroid	0.84	-0.28	0.12	-0.21	-0.33	-0.06
Urinary bladder wall	-0.73	-0.23	0.20	-0.15	-0.22	0.01
Adrenals	0.81	0.37	-0.23	0.17	-0.25	-0.08
Extrathoracic airways	-0.56	-0.32	0.15	-0.12	-0.38	-0.04
Gall bladder wall	0.68	0.76	-0.51	0.51	-0.18	-0.07
Heart wall	-0.64	-0.20	0.13	-0.22	-0.27	-0.02
Kidneys	0.83	0.18	-0.11	0.04	-0.27	-0.10
Lymph	0.70	-0.04	0.04	-0.15	-0.45	-0.03

Muscle	0.81	-0.10	0.06	-0.16	-0.49	-0.04
Oral mucosa	-0.67	-0.22	0.11	-0.06	-0.29	0.00
Pancreas	0.82	0.28	-0.18	0.10	-0.26	-0.09
Prostate	-0.53	-0.31	0.21	-0.20	-0.33	-0.04
Small intestine wall	0.82	-0.11	0.06	-0.13	-0.32	-0.12
Spleen	0.83	-0.18	0.07	-0.17	-0.29	-0.05
Thymus	0.78	-0.25	0.10	-0.24	-0.33	0.02

RBC - red blood cells; WMF - white matter fast; WMS - white matter slow; GMF - grey matter fast; GMS - grey matter slow; Fast OT – fast other tissue; Slow OT – slow other tissue

Supplemental Data 2

TABLE 2

Partial rank correlation coefficient between biokinetic parameter and absorbed dose coefficient in the target organ for ^{18}F-FDG according to the ICRP approach

Target	Brain Fs	Brain Ti1	Ht wall Fs	Ht wall Ti1	Lungs Fs	Lungs Ti1	Liver Fs
Brain	0.69	0.01	-0.05	-0.03	0.01	-0.06	-0.03
Breast	-0.10	0.11	0.14	0.00	0.06	0.01	0.03
Colon	-0.05	-0.03	-0.04	0.10	0.02	-0.01	-0.05
Endosteum	0.03	0.02	0.01	-0.05	-0.03	0.07	-0.13
Liver	-0.05	0.03	0.08	0.00	-0.01	-0.03	0.67
Lungs	-0.02	-0.01	0.08	0.07	0.56	0.03	0.04
Oesophagus	-0.14	0.01	0.53	-0.05	0.18	0.04	0.08
Red marrow	-0.07	0.01	0.02	-0.01	-0.11	0.04	-0.07
Salivary glands	0.22	0.07	-0.04	0.02	-0.04	-0.01	-0.04
Skin	-0.17	0.01	0.00	-0.04	-0.06	-0.04	-0.13
Stomach wall	-0.17	-0.07	0.29	0.04	0.09	0.03	0.30
Testes	-0.15	0.05	-0.11	0.01	-0.05	-0.07	-0.06
Thyroid	-0.04	0.02	0.04	0.04	0.09	0.03	-0.09
Urinary bladder wall	0.01	-0.02	0.03	0.03	-0.03	-0.07	-0.04
Adrenals	-0.16	0.09	0.10	0.00	0.06	-0.03	0.35
Extrathoracic airways	0.43	-0.02	0.04	0.02	0.07	0.05	-0.02
Gall bladder wall	0.01	0.05	0.05	-0.01	0.03	-0.07	0.65
Heart wall	0.05	-0.04	0.71	-0.04	0.02	-0.01	0.03
Kidneys	-0.28	-0.06	-0.06	0.09	0.08	0.07	0.09
Lymph	-0.08	0.09	0.12	-0.03	0.10	-0.02	-0.05
Muscle	-0.21	0.02	-0.11	-0.05	0.01	0.10	-0.07
Oral mucosa	0.19	-0.05	-0.05	0.06	-0.06	-0.01	-0.07
Pancreas	-0.10	-0.08	-0.02	0.01	0.05	-0.09	0.29
Prostate	0.01	-0.01	0.00	-0.09	0.01	-0.05	-0.11
Small intestine wall	-0.12	0.04	-0.03	-0.03	0.01	0.05	-0.06
Spleen	-0.19	0.08	0.21	0.01	0.14	-0.01	-0.03
Thymus	-0.19	0.06	0.23	0.01	0.09	-0.03	-0.08

Target	Liver Ti1	Others Ti1	Others ai1	Others Ti2	Others ai2	Others Ti3	UB cont Ti1
Brain	-0.01	0.03	0.02	0.00	-0.03	0.01	0.04
Breast	-0.01	0.05	-0.09	0.07	-0.01	0.00	-0.13
Colon	-0.07	-0.05	-0.05	0.06	-0.08	-0.02	0.03
Endosteum	-0.04	0.08	-0.13	0.02	0.03	-0.08	-0.04
Liver	-0.03	-0.05	-0.02	0.02	0.02	0.11	0.02
Lungs	0.02	-0.07	-0.05	0.01	-0.03	0.07	0.00
Oesophagus	0.05	-0.02	-0.07	0.06	-0.14	-0.06	-0.07
Red marrow	-0.02	0.04	-0.05	0.07	-0.16	0.03	0.02
Salivary glands	-0.01	-0.08	-0.01	-0.04	-0.08	-0.02	0.06

Skin	0.02	0.01	-0.04	0.01	-0.14	0.02	0.02
Stomach wall	-0.03	0.07	-0.04	0.17	-0.15	-0.04	-0.01
Testes	0.04	0.01	-0.06	0.13	-0.04	0.02	0.01
Thyroid	0.11	-0.06	0.01	0.05	-0.17	-0.03	-0.01
Urinary bladder wall	0.01	-0.03	-0.01	0.02	-0.03	-0.01	0.09
Adrenals	0.02	0.06	-0.12	0.15	-0.11	-0.06	-0.09
Extrathoracic airways	0.00	-0.02	-0.02	0.09	-0.09	-0.07	0.06
Gall bladder wall	0.00	0.08	-0.12	-0.01	0.00	0.05	-0.02
Heart wall	-0.08	0.01	0.04	-0.01	-0.06	-0.05	0.02
Kidneys	0.07	0.05	-0.10	0.14	-0.09	0.04	0.04
Lymph	-0.02	-0.03	-0.02	-0.01	-0.09	-0.01	-0.01
Muscle	0.07	-0.09	-0.09	0.11	-0.07	-0.03	0.01
Oral mucosa	-0.01	0.01	-0.02	0.00	-0.09	0.03	0.01
Pancreas	-0.01	0.07	-0.06	0.08	-0.09	-0.06	0.08
Prostate	0.04	-0.03	-0.04	0.06	-0.01	-0.01	0.05
Small intestine wall	0.02	0.01	-0.05	0.13	-0.08	-0.01	0.03
Spleen	0.06	0.08	-0.11	0.16	-0.12	0.08	-0.09
Thymus	-0.03	-0.01	0.03	0.07	-0.19	0.06	-0.01

Ht wall – heart wall; Others - other tissue; UB cont - urinary bladder contents

Supplemental Data 3

TABLE 3

Partial rank correlation coefficient between biokinetic parameter and absorbed dose coefficients in the target organ for ^{99m}Tc-pertechnetate according to the ICRP approach

Target	Thyroid Fs	Thyroid Ti1	Thyroid Ti2	Thyroid ai2	Sgland Fs	Sgland Ti1	Sgland Ti2	Sgland ai2
Brain	0.01	0.07	-0.08	0.08	0.07	0.03	-0.06	0.04
Breast	-0.03	-0.04	0.05	-0.06	-0.03	0.03	-0.09	0.06
Colon	-0.14	0.02	-0.08	0.06	0.06	0.06	-0.04	0.03
Endosteum	0.03	0.03	0.04	0.04	0.05	-0.01	-0.08	0.01
Liver	-0.04	0.02	0.04	0.01	-0.03	0.01	-0.03	0.00
Lungs	-0.02	0.05	-0.01	-0.03	-0.12	-0.04	0.02	-0.08
Oesophagus	0.13	0.05	-0.07	0.00	-0.10	0.08	-0.03	0.00
Red marrow	0.03	-0.01	-0.03	0.06	0.00	0.02	0.03	0.02
Salivary glands	-0.03	0.05	0.07	-0.03	0.49	0.31	0.06	0.17
Skin	-0.05	0.00	0.06	0.09	-0.07	0.09	-0.01	0.04
Stomach wall	-0.06	0.01	0.03	-0.06	0.07	0.04	0.03	-0.03
Testes	-0.07	0.02	-0.04	-0.06	-0.01	-0.02	0.00	0.03
Thyroid	0.90	0.72	0.29	0.57	-0.02	-0.04	0.04	-0.04
Urinary bladder wall	-0.10	-0.02	0.02	0.10	0.02	0.10	-0.02	0.02
Adrenals	-0.02	-0.08	-0.02	-0.06	-0.07	-0.08	-0.01	0.05
Extrathoracic airways	0.06	0.09	0.00	0.00	0.14	0.07	-0.01	-0.04
Gall bladder wall	-0.08	0.05	-0.08	-0.06	-0.04	0.01	0.13	0.01
Heart wall	-0.02	0.06	0.07	0.02	-0.02	-0.02	0.08	0.02
Kidneys	0.03	-0.01	-0.07	-0.02	-0.06	-0.02	-0.01	0.03
Lymph	0.01	0.01	0.06	-0.04	-0.03	-0.07	-0.02	0.06
Muscle	-0.06	0.06	0.02	0.01	-0.01	-0.06	0.05	0.02
Oral mucosa	0.05	0.05	-0.07	0.02	0.14	0.09	0.03	0.09
Pancreas	-0.01	-0.04	-0.05	-0.02	0.03	0.01	0.01	0.06
Prostate	-0.06	-0.07	-0.03	0.06	-0.02	0.03	0.01	0.02
Small intestine wall	0.03	0.05	0.00	0.08	-0.02	0.01	-0.03	0.04
Spleen	-0.03	0.04	-0.02	0.02	0.01	0.04	0.02	-0.02
Thymus	0.14	0.02	0.01	-0.04	-0.12	-0.01	0.00	0.04

Target	St wall Fs	St wall Ti1	ULI wall Ti1	ULI wall Tj1	Others Ti1	Others ai1	Others Ti2	Others ai2
Brain	-0.34	-0.02	-0.05	0.00	0.11	-0.13	0.21	-0.09
Breast	-0.24	0.17	0.02	-0.02	0.09	-0.17	0.09	0.01
Colon	-0.13	0.04	0.18	-0.15	0.04	0.01	0.00	-0.04
Endosteum	-0.17	0.03	0.08	-0.09	0.00	-0.08	0.00	0.00
Liver	-0.11	0.12	0.13	-0.05	-0.01	-0.06	0.12	-0.02
Lungs	-0.40	0.23	0.05	0.01	0.24	-0.22	0.23	-0.17
Oesophagus	-0.15	0.15	-0.01	0.02	0.07	-0.20	0.17	0.01
Red marrow	-0.24	0.05	0.00	-0.06	0.09	-0.05	0.11	-0.14
Salivary glands	-0.11	-0.02	0.05	-0.02	0.02	-0.10	0.07	0.03

Skin	-0.35	0.03	0.06	-0.07	0.05	-0.15	0.09	-0.12
Stomach wall	0.42	0.38	-0.02	-0.01	-0.07	0.01	0.03	-0.03
Testes	-0.24	-0.06	0.03	-0.02	0.03	-0.07	0.07	-0.06
Thyroid	-0.17	0.06	0.04	0.02	0.06	0.02	0.05	-0.09
Urinary bladder wall	-0.08	-0.11	0.01	0.01	0.01	-0.02	-0.03	0.03
Adrenals	-0.03	0.06	0.02	-0.01	0.07	-0.15	0.10	0.04
Extrathoracic airways	-0.28	-0.01	0.03	-0.06	0.05	-0.12	0.03	-0.03
Gall bladder wall	0.00	0.04	0.04	-0.11	0.10	-0.03	0.03	0.01
Heart wall	-0.01	0.40	-0.03	-0.02	0.11	-0.08	0.11	-0.16
Kidneys	-0.07	0.06	0.06	-0.12	0.18	-0.05	0.12	-0.03
Lymph	0.03	0.07	0.10	-0.10	0.08	-0.09	0.01	-0.03
Muscle	-0.24	0.03	-0.09	-0.01	0.02	-0.07	0.09	-0.10
Oral mucosa	-0.39	0.05	0.00	0.01	0.05	-0.09	0.15	-0.17
Pancreas	0.13	0.20	0.01	-0.01	0.00	0.04	0.04	-0.08
Prostate	-0.18	0.02	0.02	-0.09	0.00	-0.03	0.03	-0.09
Small intestine wall	-0.02	0.14	0.15	-0.08	0.07	-0.06	0.05	-0.01
Spleen	0.10	0.30	-0.02	-0.04	0.05	-0.09	0.03	-0.01
Thymus	-0.21	0.04	0.05	0.03	0.06	-0.13	0.06	-0.01

Target	Others Ti3	St cont Ti1	SI cont Ti1	ULI cont Ti1	LLI cont Ti1	Kidneys Ti1	UB cont Ti1
Brain	0.11	-0.03	-0.01	-0.02	0.00	-0.04	0.02
Breast	0.14	0.04	0.02	0.05	-0.04	-0.12	0.04
Colon	0.02	0.08	-0.04	0.04	0.01	-0.01	-0.01
Endosteum	0.06	0.02	0.00	0.04	-0.01	-0.02	-0.03
Liver	-0.01	0.01	-0.05	0.11	-0.06	0.00	0.00
Lungs	0.14	0.04	-0.05	-0.02	0.05	0.01	0.00
Oesophagus	0.15	-0.02	0.02	-0.04	-0.08	-0.01	0.04
Red marrow	0.12	-0.01	0.05	0.07	0.14	0.00	0.12
Salivary glands	0.05	0.04	0.04	-0.03	0.03	0.00	0.01
Skin	0.11	0.04	-0.02	0.04	0.04	-0.01	0.06
Stomach wall	0.04	0.03	-0.01	0.06	0.08	0.03	-0.08
Testes	0.11	0.08	-0.02	-0.10	0.01	-0.02	0.07
Thyroid	0.10	0.05	-0.03	-0.02	-0.04	-0.05	0.03
Urinary bladder wall	-0.05	0.06	0.04	0.00	0.00	0.03	0.20
Adrenals	0.08	0.04	0.00	0.02	-0.01	-0.02	-0.03
Extrathoracic airways	0.08	0.00	-0.06	0.02	-0.03	-0.05	0.04
Gall bladder wall	-0.02	-0.01	0.00	0.02	0.03	0.04	0.06
Heart wall	0.14	0.07	0.00	0.04	0.02	0.02	0.01
Kidneys	0.01	0.01	0.02	-0.05	0.09	0.18	0.05
Lymph	0.06	0.01	-0.09	0.00	0.20	0.02	0.17
Muscle	0.08	0.00	0.02	0.00	0.01	0.06	0.04
Oral mucosa	0.09	-0.01	0.02	-0.01	-0.01	-0.01	-0.04
Pancreas	0.01	0.02	0.02	0.07	0.01	-0.04	0.04
Prostate	0.15	-0.04	0.05	0.00	0.01	-0.04	0.39
Small intestine wall	0.07	-0.07	-0.06	-0.01	0.10	0.02	0.14
Spleen	0.05	0.02	0.01	-0.01	0.07	-0.03	0.03

Thymus	0.10	0.02	-0.06	0.01	-0.03	0.06	-0.04

Sgland – salivary glands; St wall – stomach wall; ULI wall – upper large intestine wall; Others – other tissue; St cont – stomach contents; SI cont – small intestine contents; ULI cont – upper large intestine contents; LLI cont – lower large intestine contents; UB cont – urinary bladder contents

Supplemental Data 4

TABLE 4

Partial rank correlation coefficient between biokinetic parameter and absorbed dose coefficients in the target organ for ^{99m}Tc-phosphonate according to the ICRP approach

Target	Bone Fs	Bone Ti1	Bone ai1	Bone Ti2	Bone Tj1	Kidneys Fs	Kidneys Ti1
Brain	0.07	0.06	-0.04	0.02	-0.02	0.06	-0.02
Breast	-0.35	0.02	-0.05	0.01	0.00	0.01	-0.01
Colon	0.02	-0.01	-0.06	0.00	0.06	0.04	-0.01
Endosteum	-0.21	-0.01	-0.16	0.09	-0.05	-0.06	-0.08
Liver	-0.14	0.03	0.00	-0.03	-0.05	-0.01	0.05
Lungs	0.04	-0.05	-0.03	0.02	-0.01	-0.03	0.05
Oesophagus	0.11	0.03	-0.06	0.03	-0.11	0.06	-0.03
Red marrow	0.16	-0.07	-0.06	0.05	-0.02	-0.05	-0.05
Salivary glands	-0.46	0.06	-0.11	0.05	0.00	0.03	0.01
Skin	0.01	0.04	-0.08	0.07	-0.04	0.00	-0.08
Stomach wall	-0.13	-0.05	-0.09	0.05	-0.08	0.05	-0.05
Testes	-0.44	-0.02	-0.04	0.00	-0.03	-0.03	0.00
Thyroid	0.12	0.01	-0.02	0.06	-0.01	0.00	-0.09
Urinary bladder wall	0.04	-0.03	0.00	0.06	-0.03	-0.02	0.01
Adrenals	0.01	0.05	-0.04	0.07	-0.02	0.03	0.01
Extrathoracic airways	-0.44	0.02	-0.12	0.02	-0.04	-0.10	0.03
Gall bladder wall	-0.09	0.06	-0.02	0.00	-0.06	0.18	-0.01
Heart wall	0.00	-0.04	-0.04	-0.09	-0.10	0.03	-0.02
Kidneys	-0.05	0.01	-0.07	-0.03	-0.02	0.28	0.09
Lymph	-0.17	-0.04	-0.07	0.00	0.00	0.08	0.02
Muscle	0.09	0.09	-0.01	0.04	-0.05	0.00	0.04
Oral mucosa	-0.48	0.05	-0.18	0.10	-0.02	-0.01	-0.03
Pancreas	-0.08	-0.02	-0.05	-0.03	0.05	0.08	0.06
Prostate	-0.01	-0.05	0.04	-0.01	0.07	-0.08	0.11
Small intestine wall	-0.03	0.00	-0.05	-0.09	0.00	-0.02	0.04
Spleen	-0.08	0.06	-0.11	-0.02	-0.01	0.12	-0.02
Thymus	0.03	0.00	-0.12	0.03	0.02	0.02	0.00

Target	Kidneys ai1	Kidneys Ti2	Kidneys ai2	Kidneys Ti3	UB cont Ti1	Others Ti1
Brain	0.02	-0.02	-0.02	-0.07	0.01	0.01
Breast	-0.07	0.05	0.09	0.07	0.02	0.08
Colon	-0.04	0.05	0.00	0.06	0.18	0.06
Endosteum	0.05	0.02	-0.06	-0.05	0.17	0.01
Liver	-0.07	0.03	0.07	-0.01	0.05	0.04
Lungs	0.01	-0.03	-0.02	-0.05	0.02	0.06
Oesophagus	0.02	0.05	0.00	0.08	-0.01	-0.03
Red marrow	-0.04	0.01	0.07	0.01	0.03	0.03
Salivary glands	0.07	0.01	-0.10	-0.01	0.03	0.06

Skin	0.03	0.04	-0.03	-0.02	0.07	0.05
Stomach wall	-0.02	0.01	-0.01	0.05	-0.01	0.05
Testes	0.02	0.08	-0.03	0.03	0.30	0.04
Thyroid	-0.02	0.05	-0.01	0.06	-0.01	0.06
Urinary bladder wall	0.01	0.04	-0.01	0.01	0.16	-0.01
Adrenals	-0.08	0.01	0.02	0.01	0.03	0.03
Extrathoracic airways	-0.09	-0.05	0.05	-0.08	0.09	0.09
Gall bladder wall	-0.08	-0.04	0.05	-0.04	-0.01	0.05
Heart wall	-0.03	-0.07	0.05	-0.01	0.00	0.00
Kidneys	-0.07	0.09	-0.10	0.07	-0.04	-0.03
Lymph	-0.04	0.00	0.03	-0.01	0.29	-0.02
Muscle	0.01	0.03	-0.01	-0.04	0.10	-0.02
Oral mucosa	-0.07	-0.09	0.08	-0.04	-0.08	0.14
Pancreas	-0.03	0.02	-0.02	0.06	0.05	0.07
Prostate	-0.01	-0.01	-0.01	-0.01	0.26	0.04
Small intestine wall	0.01	0.01	-0.01	-0.01	0.17	0.09
Spleen	-0.10	-0.04	0.06	-0.03	-0.06	0.07
Thymus	0.00	-0.06	-0.02	0.03	-0.07	0.03

UB cont – urinary bladder contents; Others – other tissue

Supplemental Data 5

TABLE 5

Partial rank correlation coefficient between biokinetic parameter and absorbed dose coefficients in the target organ for ^{99m}Tc-sestamibi according to the ICRP approach

Target	Ht wall Fs	Ht wall Ti1	Ht wall Ti2	Ht wall ai2	Kidneys Fs	Kidneys Ti1	Muscles Fs	Muscles Ti1
Brain	-0.16	0.11	0.02	0.02	-0.70	0.01	-0.77	0.06
Breast	-0.04	0.13	0.12	-0.01	-0.31	0.05	-0.21	0.07
Colon	-0.08	0.03	0.03	0.02	0.05	0.09	-0.07	-0.02
Endosteum	-0.05	-0.03	-0.05	0.04	-0.16	0.11	-0.14	0.06
Liver	0.04	0.08	-0.04	-0.04	0.19	0.13	0.04	0.04
Lungs	0.13	0.09	0.03	0.01	-0.31	0.17	-0.29	0.07
Oesophagus	0.22	0.12	0.00	-0.04	-0.22	0.20	-0.27	0.17
Red marrow	-0.06	0.00	0.00	0.08	-0.09	0.11	0.01	0.17
Salivary glands	-0.01	0.05	0.08	-0.01	-0.04	0.03	-0.03	0.03
Skin	-0.01	0.06	-0.07	-0.08	-0.14	0.06	-0.06	0.06
Stomach wall	-0.03	0.07	-0.01	0.07	0.12	0.08	-0.18	0.05
Testes	-0.09	-0.01	0.04	-0.06	-0.23	-0.02	0.04	0.10
Thyroid	-0.06	0.03	-0.08	-0.04	-0.30	-0.03	0.17	0.08
Urinary bladder wall	-0.02	-0.08	0.00	0.04	-0.01	0.04	0.01	0.05
Adrenals	0.00	0.02	-0.01	-0.10	0.35	0.26	-0.07	0.10
Extrathoracic airways	-0.02	-0.02	0.01	0.02	-0.32	-0.02	-0.18	0.07
Gall bladder wall	-0.06	0.01	0.03	0.07	0.05	0.09	-0.01	-0.07
Heart wall	0.49	0.15	0.14	0.14	-0.13	0.07	-0.15	0.05
Kidneys	-0.03	-0.02	-0.02	0.01	0.71	0.50	-0.10	0.01
Lymph	-0.01	0.04	0.02	0.09	-0.01	0.09	-0.08	0.04
Muscle	-0.04	-0.04	-0.01	-0.05	-0.15	0.11	0.15	0.02
Oral mucosa	-0.01	-0.08	-0.01	0.07	-0.28	-0.03	-0.18	0.08
Pancreas	0.00	0.06	-0.05	-0.03	0.05	0.11	-0.07	0.02
Prostate	-0.02	0.07	-0.08	-0.01	-0.14	-0.03	-0.06	0.09
Small intestine wall	0.10	0.07	-0.06	-0.03	0.09	0.12	-0.09	-0.02
Spleen	0.06	-0.06	-0.01	0.02	0.42	0.21	-0.16	-0.09
Thymus	0.24	-0.02	0.05	0.06	-0.32	0.09	-0.29	0.04

Target	Sgland Fs	Sgland Ti1	Thyroid Fs	Thyroid Ti1	Others Ti1	Liver Fs	Liver Ti1
Brain	0.14	0.06	0.07	0.03	0.55	-0.80	0.07
Breast	0.04	-0.03	0.01	0.00	0.22	-0.25	0.09
Colon	-0.01	0.00	0.00	-0.03	-0.01	-0.07	0.03
Endosteum	0.07	-0.02	0.00	0.01	0.07	-0.21	-0.06
Liver	0.02	-0.03	0.00	0.07	0.03	0.60	0.43
Lungs	-0.07	0.00	0.04	0.08	0.25	-0.24	0.18
Oesophagus	0.03	0.06	-0.07	0.04	0.39	-0.16	0.34
Red marrow	0.01	0.04	0.02	-0.04	0.09	-0.28	0.13
Salivary glands	0.52	0.16	0.02	0.00	-0.04	-0.06	-0.02

Skin	0.00	0.10	0.04	-0.10	0.20	-0.29	0.01
Stomach wall	-0.02	-0.03	0.04	0.00	0.04	0.01	0.09
Testes	-0.07	-0.09	-0.03	0.02	0.18	-0.25	0.05
Thyroid	0.10	0.06	0.61	0.48	0.20	-0.28	0.01
Urinary bladder wall	0.06	0.07	0.02	-0.02	0.06	0.00	-0.05
Adrenals	-0.07	0.00	0.02	-0.01	-0.04	0.07	-0.05
Extrathoracic airways	0.18	0.08	0.06	-0.02	0.16	-0.32	0.11
Gall bladder wall	0.02	-0.01	0.05	-0.04	-0.02	0.05	0.00
Heart wall	0.01	0.00	0.01	0.05	0.18	0.03	0.14
Kidneys	-0.01	0.01	0.01	0.08	0.09	-0.01	0.09
Lymph	0.07	0.09	0.04	0.08	0.12	-0.12	0.07
Muscle	-0.02	-0.06	-0.04	-0.06	0.11	-0.19	0.11
Oral mucosa	0.25	0.03	-0.04	-0.01	0.21	-0.41	0.02
Pancreas	0.03	-0.10	-0.08	-0.08	-0.03	0.02	0.01
Prostate	-0.06	0.05	0.00	-0.02	0.12	-0.22	-0.01
Small intestine wall	-0.02	-0.12	0.02	-0.02	0.04	-0.13	0.05
Spleen	-0.01	0.00	0.04	-0.03	0.15	-0.19	0.01
Thymus	-0.03	-0.03	-0.04	0.06	0.25	-0.40	0.08

Target	Liver Ti2	Liver ai2	GB cont Ti1	SI cont Ti1	ULI cont Ti1	LLI cont Ti1	UB cont Ti1
Brain	0.07	0.10	-0.07	-0.02	0.06	-0.04	0.02
Breast	0.07	0.12	0.04	0.05	-0.01	-0.05	0.09
Colon	0.05	-0.04	0.06	0.00	0.21	0.11	-0.05
Endosteum	0.04	0.01	0.11	0.08	-0.02	0.03	-0.01
Liver	0.11	0.26	0.03	-0.02	-0.07	-0.05	-0.02
Lungs	0.10	0.15	0.04	0.06	-0.02	0.04	0.04
Oesophagus	0.15	0.11	0.07	0.01	-0.07	-0.09	-0.01
Red marrow	-0.03	0.10	0.09	0.06	-0.01	0.15	0.04
Salivary glands	0.03	0.01	0.01	0.03	-0.08	-0.04	0.07
Skin	0.09	0.06	0.03	0.10	0.06	0.01	0.02
Stomach wall	0.06	0.05	0.08	0.06	0.07	0.04	0.04
Testes	-0.01	0.04	0.02	0.02	0.04	0.02	0.05
Thyroid	0.00	0.03	0.00	-0.02	0.07	-0.03	0.06
Urinary bladder wall	0.04	-0.06	-0.01	0.00	-0.01	0.06	0.03
Adrenals	-0.02	0.07	0.02	0.11	0.01	0.08	0.00
Extrathoracic airways	0.01	-0.08	-0.02	0.02	0.06	-0.02	-0.05
Gall bladder wall	0.00	0.11	0.01	-0.03	0.05	0.02	-0.04
Heart wall	0.05	0.12	0.05	0.13	0.05	-0.04	-0.02
Kidneys	-0.01	-0.02	-0.08	0.06	-0.05	0.00	-0.06
Lymph	-0.06	0.05	0.00	0.12	0.05	0.37	0.01
Muscle	0.05	0.05	-0.03	0.04	0.07	0.07	0.00
Oral mucosa	0.01	0.02	0.02	-0.02	0.07	0.09	0.05
Pancreas	-0.07	0.07	-0.01	0.05	0.03	0.04	0.01
Prostate	0.03	0.06	-0.07	0.10	0.03	0.08	0.13
Small intestine wall	0.07	0.04	-0.02	0.23	0.21	0.10	0.03
Spleen	-0.02	0.08	-0.05	0.02	0.01	0.02	0.04

Thymus	0.01	0.10	0.00	-0.05	0.04	0.02	0.05

Ht wall – heart wall; Sgland – salivary glands; Others – other tissue; GB cont – gall bladder contents; SI cont – small intestine contents; ULI cont – upper large intestine contents; LLI cont – lower large intestine contents; UB cont – urinary bladder contents

Supplemental Data 6

TABLE 6

Partial rank correlation coefficient between biokinetic parameter and absorbed dose coefficients in the target organ for ^{99m}Tc-tetrofosmin according to the ICRP approach

Target	Ht wall Fs	Ht wall Ti1	Ht wall Ti2	Ht wall ai2	Liver Fs	Liver Ti1	Liver Ti2	Liver ai2
Brain	0.03	-0.03	-0.02	-0.02	-0.16	-0.05	0.01	0.02
Breast	0.03	-0.02	-0.01	0.05	-0.09	0.04	0.03	0.09
Colon	0.08	0.02	0.11	0.02	-0.09	0.04	0.02	0.06
Endosteum	-0.05	-0.02	-0.01	-0.03	-0.10	0.10	0.00	-0.03
Liver	-0.03	0.00	0.10	0.03	0.13	0.07	0.07	0.15
Lungs	0.18	-0.05	0.01	0.03	-0.29	0.03	0.08	0.06
Oesophagus	0.12	-0.04	0.07	0.05	-0.18	0.01	-0.02	0.01
Red marrow	0.08	-0.03	0.01	0.03	-0.15	0.06	-0.03	0.05
Salivary glands	0.03	0.02	0.06	-0.03	0.00	-0.07	0.03	-0.06
Skin	0.01	0.00	0.03	0.09	-0.18	-0.01	0.07	0.00
Stomach wall	-0.02	-0.05	-0.01	-0.02	-0.06	-0.03	0.05	0.08
Testes	0.05	-0.05	0.09	0.01	-0.11	-0.05	-0.12	-0.05
Thyroid	0.02	-0.03	0.11	0.02	-0.19	0.04	0.03	-0.06
Urinary bladder wall	0.08	0.10	0.01	-0.10	-0.07	-0.02	-0.01	0.04
Adrenals	0.02	0.00	0.04	0.03	-0.04	-0.02	0.02	0.00
Extrathoracic airways	-0.01	-0.03	0.02	-0.01	-0.08	0.01	-0.01	0.01
Gall bladder wall	0.09	-0.07	0.02	-0.07	-0.02	-0.10	0.07	-0.04
Heart wall	0.55	0.21	0.10	0.18	-0.11	0.00	-0.04	0.06
Kidneys	0.01	0.00	-0.03	-0.09	-0.05	0.05	-0.10	-0.01
Lymph	0.01	0.05	-0.07	-0.09	-0.12	0.00	0.06	-0.09
Muscle	-0.03	0.02	-0.04	-0.01	-0.01	0.05	-0.03	0.04
Oral mucosa	0.04	0.01	-0.06	-0.04	-0.18	-0.07	0.01	-0.04
Pancreas	-0.01	-0.05	-0.07	-0.06	-0.01	0.00	0.09	-0.01
Prostate	-0.06	-0.01	0.07	-0.02	-0.14	0.01	0.04	-0.05
Small intestine wall	-0.01	-0.08	0.06	0.01	-0.04	0.03	0.03	0.05
Spleen	0.09	0.05	0.02	0.03	-0.06	-0.02	0.01	0.01
Thymus	0.09	0.08	0.02	-0.02	-0.24	0.01	-0.03	-0.04

Target	Kidneys Fs	Kidneys Ti1	Kidneys Ti2	Kidneys ai2	Sgland Fs	Sgland Ti1	Thyroid Fs	Thyroid Ti1
Brain	-0.11	0.00	-0.06	0.07	0.04	0.07	0.00	-0.03
Breast	-0.15	-0.03	-0.01	-0.01	0.02	0.02	-0.04	-0.02
Colon	0.06	0.02	0.02	-0.02	0.04	0.09	0.00	0.04
Endosteum	-0.07	0.00	-0.01	-0.03	0.03	0.04	0.02	0.02
Liver	0.06	0.08	0.03	0.07	-0.01	0.02	-0.05	-0.01
Lungs	-0.10	0.01	-0.04	0.12	-0.13	0.03	-0.05	-0.02
Oesophagus	0.00	0.00	0.01	0.00	0.00	0.02	0.12	-0.02
Red marrow	0.03	-0.02	0.00	0.02	-0.01	0.11	0.03	0.00

Salivary glands	-0.07	0.01	0.08	0.03	0.49	0.19	0.04	0.08
Skin	-0.11	-0.04	0.02	0.05	0.06	0.06	-0.01	-0.05
Stomach wall	0.04	0.01	0.04	0.02	0.01	0.06	0.00	0.01
Testes	-0.08	0.00	-0.04	-0.04	-0.04	0.01	-0.03	0.00
Thyroid	-0.17	0.02	0.07	0.02	0.07	-0.04	0.61	0.49
Urinary bladder wall	0.02	0.03	0.02	0.02	0.06	-0.07	0.05	-0.07
Adrenals	0.24	0.03	-0.05	0.17	-0.03	0.06	0.06	-0.03
Extrathoracic airways	-0.17	-0.02	0.00	-0.04	0.24	-0.01	0.03	0.03
Gall bladder wall	-0.05	0.05	0.05	0.00	-0.03	0.07	0.04	0.15
Heart wall	-0.06	-0.01	0.10	0.13	-0.03	0.04	0.00	0.02
Kidneys	0.46	0.10	0.05	0.30	-0.12	0.00	0.02	-0.02
Lymph	0.02	0.08	0.02	0.17	-0.03	0.02	-0.08	-0.07
Muscle	-0.08	-0.06	-0.02	0.05	-0.04	0.04	-0.03	0.00
Oral mucosa	-0.11	0.06	0.00	-0.04	0.27	0.08	0.00	-0.02
Pancreas	0.07	0.09	0.01	0.06	0.00	0.01	0.00	0.00
Prostate	-0.09	0.02	-0.01	0.00	-0.09	0.01	-0.04	-0.05
Small intestine wall	0.02	0.01	0.03	0.08	-0.04	0.01	0.00	-0.07
Spleen	0.01	0.03	-0.05	0.07	0.08	-0.07	-0.02	-0.03
Thymus	-0.13	-0.16	-0.03	0.12	0.03	-0.02	0.04	0.02

Target	Others Ti1	Others ai1	Others Ti2	GB cont Ti1	SI cont Ti1	ULI cont Ti1	LLI cont Ti1	UB cont Ti1
Brain	0.04	-0.25	0.29	0.04	0.01	0.05	-0.04	0.02
Breast	0.00	-0.20	0.23	-0.01	0.09	0.03	0.04	0.06
Colon	-0.10	-0.05	0.02	0.00	0.03	0.12	0.13	0.10
Endosteum	0.03	-0.17	0.07	-0.08	0.01	-0.01	0.01	0.00
Liver	-0.02	-0.09	0.01	0.09	0.13	0.05	0.06	-0.04
Lungs	0.00	-0.42	0.51	0.01	-0.03	-0.04	0.10	-0.07
Oesophagus	0.02	-0.22	0.20	-0.04	-0.04	0.04	0.02	-0.01
Red marrow	0.02	-0.24	0.30	0.01	0.14	0.04	0.01	0.02
Salivary glands	0.02	0.04	0.07	0.00	-0.03	-0.01	0.04	0.03
Skin	0.02	-0.30	0.37	0.01	0.09	0.06	-0.05	0.07
Stomach wall	0.05	-0.02	0.11	0.01	-0.04	0.05	0.06	0.04
Testes	0.01	-0.12	0.20	0.04	0.00	0.03	0.03	-0.05
Thyroid	-0.01	-0.23	0.39	0.07	-0.02	0.10	-0.04	0.03
Urinary bladder wall	0.06	-0.02	0.04	0.01	0.07	-0.02	-0.04	0.18
Adrenals	0.04	-0.08	0.02	0.14	-0.01	-0.02	-0.06	-0.09
Extrathoracic airways	0.05	-0.18	0.23	0.05	-0.04	0.02	0.06	-0.08
Gall bladder wall	0.09	-0.06	0.03	0.11	-0.02	-0.02	-0.08	0.04
Heart wall	0.05	-0.28	0.29	0.04	0.01	0.04	0.01	-0.06
Kidneys	0.04	-0.12	0.02	0.06	0.10	0.03	-0.02	0.03
Lymph	0.08	-0.16	0.25	-0.04	0.13	0.05	0.30	0.11
Muscle	0.03	-0.21	0.25	-0.07	-0.02	0.07	0.00	0.00
Oral mucosa	-0.01	-0.12	0.19	-0.01	0.02	0.06	0.00	0.05
Pancreas	0.05	-0.11	0.04	0.09	-0.03	0.06	0.04	0.02
Prostate	0.07	-0.15	0.18	0.02	0.12	-0.02	0.06	0.26
Small intestine wall	-0.07	-0.04	0.20	0.00	0.27	0.14	0.08	0.09

Spleen	0.07	-0.14	0.12	-0.05	0.09	0.01	-0.09	-0.04
Thymus	0.07	-0.28	0.27	-0.02	0.04	0.03	0.10	0.01

Ht wall – heart wall; Sgland – salivary glands; Others – other tissue; GB cont – gall bladder contents; SI cont –small intestine contents; ULI cont – upper large intestine contents; LLI cont – lower large intestine contents; UB cont – urinary bladder contents

Supplemental Data 7

TABLE 7

Partial rank correlation coefficient between biokinetic parameter and absorbed dose coefficients in the target organ for ^{99m}Tc-MAA according to the ICRP approach

Target	Lungs Ti1	Lungs Ti2	Lungs ai2	Liver Fs	Liver Ti1	Liver Tj1	Kidneys Ti1	UB cont Ti1	Others Ti1
Brain	0.15	-0.05	0.09	-0.29	-0.09	0.01	-0.01	0.01	0.15
Breast	0.18	0.00	0.04	0.13	-0.09	-0.03	-0.05	0.02	-0.02
Colon	0.14	-0.01	0.03	0.15	0.03	-0.09	0.03	0.11	0.03
Endosteum	0.02	-0.01	0.01	-0.03	-0.07	0.00	-0.04	-0.04	0.04
Liver	0.34	0.03	0.07	0.78	0.07	-0.59	-0.02	-0.04	0.00
Lungs	0.41	0.03	0.09	0.15	0.09	-0.01	0.01	0.03	0.03
Oesophagus	0.42	-0.01	0.18	0.18	0.01	-0.04	-0.02	0.01	-0.05
Red marrow	0.31	0.04	0.09	0.10	0.04	-0.13	0.05	0.03	0.05
Salivary glands	0.27	-0.08	0.13	-0.15	-0.03	0.00	0.05	-0.05	0.06
Skin	0.29	0.01	0.12	0.04	-0.07	-0.11	0.00	-0.04	0.08
Stomach wall	0.35	-0.02	0.08	0.26	0.06	-0.11	0.05	0.02	0.05
Testes	-0.02	0.07	-0.02	-0.26	0.01	0.03	0.05	0.14	0.07
Thyroid	0.25	0.04	0.07	-0.08	0.02	0.02	0.07	0.00	-0.06
Urinary bladder wall	-0.02	-0.01	-0.08	-0.10	0.00	-0.01	0.00	0.28	-0.03
Adrenals	0.30	0.00	0.02	0.42	0.00	-0.29	0.05	-0.02	0.01
Extrathoracic airways	0.19	0.03	0.10	-0.10	-0.04	0.02	-0.01	0.06	-0.09
Gall bladder wall	0.19	-0.03	0.10	0.75	0.10	-0.47	0.02	-0.05	-0.07
Heart wall	0.32	-0.04	0.10	0.04	0.03	0.01	-0.07	0.00	-0.01
Kidneys	0.24	-0.04	0.04	0.41	0.07	-0.22	0.04	0.01	0.02
Lymph	0.29	0.14	0.09	0.17	-0.02	-0.08	-0.01	0.09	0.03
Muscle	0.38	0.02	0.09	0.04	-0.04	-0.14	0.03	0.06	0.00
Oral mucosa	0.23	-0.02	0.09	-0.11	-0.01	0.01	0.01	0.03	0.04
Pancreas	0.27	-0.01	0.11	0.44	0.10	-0.28	-0.03	-0.07	-0.05
Prostate	0.02	0.04	0.02	-0.11	-0.01	0.05	-0.03	0.56	0.04
Small intestine wall	0.18	0.01	0.00	0.22	0.05	-0.18	0.04	0.08	0.04
Spleen	0.39	-0.04	0.15	-0.01	-0.05	-0.06	0.03	-0.01	-0.02
Thymus	0.27	-0.07	0.18	-0.01	0.00	-0.05	-0.03	-0.03	0.06

UB cont – urinary bladder contents; Others – other tissue

Supplemental Data 8

TABLE 8

Partial rank correlation coefficient between biokinetic parameter and absorbed dose coefficients in the target organ for ^{201}Tl-chloride according to the ICRP approach

Target	Bone Fs	Bone Ti1	Bone Ti2	Bone ai2	Thyroid Fs	Thyroid Ti1	Thyroid Ti2	Thyroid ai2
Brain	-0.41	-0.03	-0.06	0.06	-0.01	0.02	0.00	0.03
Breast	-0.46	-0.01	-0.11	0.01	-0.04	0.00	-0.01	-0.01
Colon	-0.24	0.01	-0.09	0.04	-0.08	0.01	0.00	0.05
Endosteum	-0.30	0.00	-0.02	0.01	-0.03	0.02	0.02	-0.04
Liver	-0.08	-0.01	0.04	0.04	0.03	-0.01	0.01	0.04
Lungs	0.07	-0.03	0.03	0.00	-0.03	-0.02	0.07	-0.02
Oesophagus	-0.46	0.04	-0.05	0.07	0.05	0.05	0.10	0.00
Red marrow	-0.36	0.04	-0.05	0.07	0.03	0.01	0.00	0.02
Salivary glands	-0.51	-0.01	-0.09	0.04	-0.01	0.03	0.02	-0.02
Skin	-0.44	0.00	-0.05	0.06	-0.03	0.06	-0.05	0.00
Stomach wall	-0.37	0.02	-0.02	-0.02	-0.01	0.02	-0.02	-0.01
Testes	-0.28	0.07	0.00	0.03	0.00	0.03	0.09	0.03
Thyroid	-0.34	0.01	-0.08	-0.05	0.32	0.08	0.04	0.04
Urinary bladder wall	-0.45	0.04	-0.07	0.01	-0.06	0.05	0.01	-0.02
Adrenals	-0.28	0.09	-0.10	0.00	-0.04	0.02	0.01	-0.01
Extrathoracic airways	-0.49	-0.02	-0.08	0.06	0.00	0.01	-0.01	0.00
Gall bladder wall	-0.34	0.08	-0.10	0.01	0.06	0.05	0.04	0.05
Heart wall	-0.04	0.01	-0.07	-0.04	-0.02	0.07	0.03	-0.03
Kidneys	-0.04	0.00	-0.02	0.05	0.03	-0.01	0.00	-0.04
Lymph	-0.42	0.04	-0.03	0.03	-0.11	-0.01	-0.05	0.01
Muscle	-0.47	0.02	-0.11	0.01	-0.01	0.03	0.03	-0.01
Oral mucosa	-0.41	-0.05	-0.05	0.00	-0.04	0.03	0.02	0.00
Pancreas	-0.34	-0.03	0.00	-0.01	0.00	0.00	-0.01	0.04
Prostate	-0.25	0.02	-0.11	0.10	0.00	0.02	-0.03	-0.02
Small intestine wall	-0.45	-0.04	-0.05	-0.02	0.03	0.05	0.03	-0.03
Spleen	0.02	-0.05	-0.08	-0.06	0.02	0.02	-0.05	0.02
Thymus	-0.39	0.00	-0.13	0.04	0.07	0.05	0.05	0.03

Target	Ht wall Fs	Ht wall Ti1	Ht wall Ti2	Ht wall ai2	Ht wall Ti3	Ht wall ai3	Lungs Fs	Lungs Ti1
Brain	-0.34	-0.04	0.09	0.08	0.03	-0.07	-0.26	0.06
Breast	-0.27	-0.04	0.00	0.03	-0.04	-0.04	-0.28	0.04
Colon	-0.15	-0.10	-0.05	-0.06	0.01	0.03	-0.21	-0.02
Endosteum	-0.24	-0.06	0.06	0.00	0.02	-0.04	-0.12	0.07
Liver	-0.04	-0.06	-0.02	-0.09	-0.05	0.07	0.02	0.00
Lungs	0.01	-0.08	0.02	0.05	0.01	-0.03	0.21	0.10
Oesophagus	-0.12	0.00	0.08	0.12	0.01	-0.05	-0.16	0.11
Red marrow	-0.27	-0.08	-0.01	0.03	-0.04	-0.09	-0.18	-0.03
Salivary glands	-0.37	-0.01	0.08	0.07	0.02	-0.08	-0.34	0.03

Skin	-0.36	0.01	0.07	0.08	0.00	-0.08	-0.31	0.07
Stomach wall	-0.22	-0.01	0.09	0.08	0.05	-0.05	-0.18	0.02
Testes	-0.27	-0.02	0.02	-0.01	-0.01	0.01	-0.09	0.08
Thyroid	-0.27	0.03	0.08	0.03	-0.02	-0.04	-0.21	0.02
Urinary bladder wall	-0.32	-0.04	0.00	0.05	0.05	-0.05	-0.26	0.06
Adrenals	-0.15	0.00	0.09	0.13	0.03	-0.11	-0.16	0.05
Extrathoracic airways	-0.37	-0.04	0.07	0.04	0.00	-0.06	-0.33	0.01
Gall bladder wall	-0.20	-0.08	0.06	0.05	0.00	-0.06	-0.14	0.03
Heart wall	0.68	0.08	0.13	0.18	0.02	0.10	-0.02	-0.02
Kidneys	0.07	0.04	-0.01	-0.07	0.08	0.07	-0.09	0.01
Lymph	-0.28	-0.02	0.04	0.06	0.00	-0.05	-0.25	0.00
Muscle	-0.34	-0.01	0.05	0.10	-0.05	-0.10	-0.31	0.05
Oral mucosa	-0.35	-0.03	0.07	0.07	0.01	-0.08	-0.31	0.02
Pancreas	-0.26	-0.11	0.02	0.07	-0.02	-0.08	-0.18	0.10
Prostate	-0.18	-0.04	-0.03	0.09	0.02	-0.09	-0.12	-0.06
Small intestine wall	-0.29	-0.02	0.08	0.07	-0.04	-0.09	-0.25	0.02
Spleen	-0.11	0.07	-0.01	0.00	-0.01	0.01	-0.08	-0.04
Thymus	-0.23	-0.09	0.11	0.06	-0.03	-0.04	-0.19	0.09

Target	Lungs Ti2	Lungs ai2	Kidneys Fs	Kidneys Ti1	Kidneys Ti2	Kidneys ai2	Liver Fs
Brain	0.04	0.02	-0.46	0.04	-0.02	-0.02	-0.61
Breast	0.02	0.01	-0.49	0.05	0.00	0.01	-0.59
Colon	-0.11	-0.01	-0.21	0.07	0.03	0.04	-0.37
Endosteum	-0.08	0.09	-0.29	0.02	0.01	0.01	-0.51
Liver	-0.02	0.06	-0.05	-0.08	-0.01	0.05	0.64
Lungs	-0.08	-0.01	0.02	0.05	-0.04	-0.01	-0.02
Oesophagus	0.01	-0.02	-0.44	0.09	0.02	-0.01	-0.55
Red marrow	-0.07	0.06	-0.33	0.00	-0.03	0.01	-0.51
Salivary glands	0.00	0.04	-0.53	0.04	-0.03	-0.03	-0.70
Skin	-0.05	0.09	-0.47	0.02	-0.02	0.00	-0.64
Stomach wall	0.00	0.02	-0.29	0.02	0.06	0.06	-0.34
Testes	0.02	-0.04	-0.23	-0.01	0.05	0.09	-0.41
Thyroid	0.00	0.02	-0.41	0.08	-0.02	-0.01	-0.55
Urinary bladder wall	-0.02	0.05	-0.47	-0.01	-0.05	-0.04	-0.59
Adrenals	0.01	0.00	0.17	0.11	0.01	0.08	-0.15
Extrathoracic airways	-0.03	0.05	-0.50	-0.01	0.00	-0.01	-0.67
Gall bladder wall	0.00	0.06	-0.21	0.06	0.07	-0.04	0.11
Heart wall	0.04	0.01	-0.06	0.10	0.05	0.09	0.04
Kidneys	0.05	-0.05	0.18	0.04	-0.07	-0.02	0.00
Lymph	-0.08	0.02	-0.28	0.01	-0.03	0.03	-0.56
Muscle	-0.08	-0.01	-0.47	0.00	-0.07	-0.03	-0.63
Oral mucosa	0.02	0.00	-0.46	0.05	0.00	0.00	-0.66
Pancreas	0.00	0.05	-0.10	0.03	0.05	0.02	-0.21
Prostate	-0.07	-0.01	-0.27	-0.05	-0.01	-0.04	-0.42
Small intestine wall	-0.03	0.06	-0.27	0.07	0.00	0.03	-0.51
Spleen	0.04	0.04	-0.03	-0.01	-0.03	-0.03	0.02

Thymus	0.00	0.02	-0.43	-0.01	0.03	0.01	-0.63

Target	Liver Ti1	Liver Ti2	Liver ai2	Spleen Fs	Spleen Ti1	Spleen Ti2	Spleen ai2
Brain	-0.07	0.00	0.07	-0.12	0.02	0.03	0.00
Breast	-0.03	0.01	0.04	-0.10	0.02	0.01	-0.01
Colon	-0.06	-0.04	0.01	-0.04	0.03	-0.03	0.04
Endosteum	-0.01	0.07	0.05	-0.05	-0.04	0.09	0.00
Liver	0.14	0.05	0.02	0.00	-0.03	-0.04	0.08
Lungs	0.03	0.00	0.02	0.02	-0.06	0.09	-0.10
Oesophagus	-0.05	0.02	0.04	-0.15	-0.03	0.05	0.01
Red marrow	-0.05	-0.04	0.11	-0.13	0.02	0.13	-0.04
Salivary glands	-0.09	0.00	0.12	-0.11	0.08	0.07	0.00
Skin	-0.09	0.01	0.06	-0.10	0.02	0.00	0.05
Stomach wall	-0.02	0.03	0.09	-0.04	0.01	0.01	0.05
Testes	-0.07	-0.05	0.07	-0.05	0.04	0.07	0.07
Thyroid	-0.06	-0.03	0.08	-0.06	0.00	0.03	0.06
Urinary bladder wall	-0.11	0.04	0.02	-0.04	0.01	0.12	0.09
Adrenals	0.01	-0.02	0.07	0.01	-0.05	-0.07	0.04
Extrathoracic airways	-0.08	0.02	0.07	-0.12	0.04	0.07	0.04
Gall bladder wall	0.05	0.03	0.07	-0.13	0.00	0.06	0.06
Heart wall	0.00	-0.06	0.03	0.06	-0.03	-0.04	0.04
Kidneys	0.01	-0.05	0.01	-0.07	-0.04	-0.01	-0.07
Lymph	0.03	0.04	0.06	-0.03	0.00	0.06	-0.01
Muscle	-0.05	0.02	0.07	-0.07	0.01	0.07	-0.04
Oral mucosa	-0.03	0.01	0.12	-0.11	0.05	0.04	-0.04
Pancreas	-0.02	0.00	0.08	-0.05	-0.04	0.02	-0.01
Prostate	-0.08	-0.01	0.01	-0.10	0.09	0.05	-0.03
Small intestine wall	-0.07	-0.03	0.11	-0.17	0.03	0.02	0.04
Spleen	0.09	0.02	-0.03	0.23	0.05	0.02	0.13
Thymus	-0.07	-0.06	0.08	-0.13	0.06	0.04	0.03

Target	R marrow Fs	R marrow Ti1	R marrow Ti2	R marrow ai2	St wall Fs	St wall Ti1	St wall Ti2
Brain	-0.45	-0.03	0.02	0.06	-0.08	-0.01	-0.01
Breast	-0.50	-0.03	-0.01	0.04	-0.04	-0.03	0.02
Colon	-0.25	-0.02	0.05	0.00	-0.10	-0.07	0.03
Endosteum	-0.33	-0.03	0.07	-0.01	-0.08	0.04	-0.01
Liver	-0.07	0.01	0.04	-0.03	0.05	0.03	0.03
Lungs	0.03	0.02	-0.07	0.03	0.05	-0.08	-0.08
Oesophagus	-0.43	-0.05	0.02	0.06	-0.10	-0.08	0.01
Red marrow	-0.31	0.02	0.04	0.03	-0.07	0.07	0.05
Salivary glands	-0.51	-0.02	0.01	0.07	-0.03	-0.01	-0.02
Skin	-0.53	-0.05	0.05	0.05	-0.02	-0.01	0.02
Stomach wall	-0.44	-0.07	0.03	0.07	0.17	0.04	0.05
Testes	-0.29	0.02	-0.04	-0.02	-0.01	-0.05	0.00
Thyroid	-0.48	-0.05	-0.01	-0.01	-0.08	-0.04	-0.04

Urinary bladder wall	-0.39	-0.01	0.05	0.05	-0.05	-0.06	-0.02
Adrenals	-0.31	-0.02	0.02	0.02	0.00	0.03	0.03
Extrathoracic airways	-0.51	-0.02	0.03	0.04	-0.07	-0.01	-0.03
Gall bladder wall	-0.34	0.00	0.05	0.08	-0.01	-0.05	-0.01
Heart wall	-0.08	0.06	0.03	0.01	0.03	0.01	0.00
Kidneys	0.00	0.00	-0.01	0.03	-0.03	-0.01	-0.01
Lymph	-0.39	0.01	0.04	0.03	-0.04	-0.02	0.00
Muscle	-0.45	-0.03	0.00	0.10	-0.05	-0.02	-0.07
Oral mucosa	-0.47	0.02	0.00	0.06	-0.04	-0.02	-0.02
Pancreas	-0.34	-0.06	0.00	0.02	0.00	0.03	0.02
Prostate	-0.23	-0.03	-0.02	-0.03	-0.10	0.00	-0.04
Small intestine wall	-0.40	-0.02	-0.04	0.06	-0.01	-0.01	-0.07
Spleen	0.05	-0.01	0.11	0.03	0.00	-0.02	-0.03
Thymus	-0.45	-0.02	-0.05	0.03	-0.12	-0.04	0.02

Target	St wall ai2	SI wall Fs	SI wall Ti1	SI wall Ti2	SI wall ai2	Muscles Fs	Muscles Ti1
Brain	-0.02	-0.29	0.01	0.03	0.07	-0.96	0.03
Breast	-0.01	-0.28	-0.02	0.06	0.05	-0.96	0.03
Colon	-0.11	-0.09	0.05	0.03	-0.03	-0.86	0.02
Endosteum	0.03	-0.16	0.05	0.05	-0.01	-0.92	0.05
Liver	-0.04	0.07	0.12	0.04	-0.06	0.07	0.00
Lungs	-0.02	0.02	-0.03	-0.01	0.06	-0.07	0.06
Oesophagus	0.05	-0.26	-0.01	0.04	0.03	-0.96	0.00
Red marrow	0.01	-0.14	0.03	0.02	0.00	-0.94	0.06
Salivary glands	0.03	-0.29	0.01	0.03	0.06	-0.97	0.01
Skin	-0.02	-0.32	0.00	0.01	0.03	-0.96	0.00
Stomach wall	0.08	-0.13	-0.03	0.08	0.01	-0.95	-0.02
Testes	0.00	-0.15	0.04	-0.04	0.02	-0.85	0.02
Thyroid	0.05	-0.25	0.00	0.00	0.00	-0.94	0.04
Urinary bladder wall	-0.01	-0.20	0.02	0.03	0.02	-0.94	0.08
Adrenals	0.03	-0.16	0.03	0.07	-0.08	-0.91	0.03
Extrathoracic airways	0.00	-0.31	0.02	0.05	0.08	-0.97	0.01
Gall bladder wall	0.01	-0.13	-0.02	-0.05	-0.01	-0.92	-0.06
Heart wall	-0.03	0.00	0.04	0.01	-0.10	-0.07	0.05
Kidneys	0.03	-0.05	-0.04	0.00	-0.11	0.00	-0.04
Lymph	0.00	-0.16	0.04	0.04	0.02	-0.95	0.04
Muscle	-0.03	-0.31	0.08	0.06	0.05	-0.96	0.08
Oral mucosa	-0.01	-0.30	0.02	0.01	0.03	-0.96	0.02
Pancreas	0.03	-0.10	0.10	0.07	0.05	-0.91	0.10
Prostate	0.03	-0.16	0.04	0.01	-0.01	-0.86	0.00
Small intestine wall	0.04	0.05	0.10	0.03	0.12	-0.94	0.10
Spleen	-0.06	0.00	-0.10	0.07	0.00	-0.25	0.00
Thymus	-0.01	-0.25	-0.02	0.02	0.11	-0.96	0.00

Target	Muscles Ti2	Muscles ai2	Testes Fs	Testes Ti1	Testes Ti2	Testes ai2	Others Ti1

Brain	-0.01	0.03	0.01	0.00	-0.09	0.03	0.24
Breast	-0.02	-0.03	0.03	0.00	-0.11	0.02	0.26
Colon	0.01	0.08	0.01	0.00	-0.03	0.00	0.08
Endosteum	-0.07	-0.02	-0.06	-0.02	-0.06	-0.06	0.27
Liver	-0.03	-0.03	0.00	-0.02	0.01	0.00	0.05
Lungs	0.09	0.03	0.03	0.04	0.03	0.02	-0.06
Oesophagus	-0.03	0.05	0.07	-0.01	-0.06	-0.08	0.30
Red marrow	0.05	-0.05	-0.01	-0.01	0.00	0.00	0.20
Salivary glands	0.01	0.00	0.01	-0.01	-0.10	0.03	0.30
Skin	0.00	0.01	0.02	-0.07	-0.15	-0.05	0.30
Stomach wall	0.05	0.03	-0.07	0.05	-0.16	0.05	0.16
Testes	-0.05	0.07	0.26	0.08	-0.02	0.07	0.13
Thyroid	-0.01	0.05	0.00	-0.02	-0.11	0.03	0.21
Urinary bladder wall	0.05	0.02	0.00	-0.04	-0.05	0.03	0.19
Adrenals	-0.04	0.06	0.10	-0.01	-0.07	-0.05	0.15
Extrathoracic airways	-0.03	0.03	0.06	-0.02	-0.12	0.04	0.25
Gall bladder wall	0.01	-0.02	0.00	-0.04	-0.05	0.06	0.23
Heart wall	0.02	-0.06	-0.02	0.00	-0.02	0.04	0.01
Kidneys	-0.08	-0.06	-0.06	0.00	-0.02	-0.05	0.02
Lymph	-0.01	0.02	0.00	-0.04	-0.13	0.00	0.22
Muscle	0.01	-0.01	0.02	0.00	-0.14	0.03	0.26
Oral mucosa	-0.01	0.00	0.01	0.01	-0.15	0.00	0.25
Pancreas	-0.01	-0.08	0.07	-0.01	-0.05	0.05	0.16
Prostate	-0.04	-0.01	0.01	0.02	-0.11	0.06	0.17
Small intestine wall	0.05	-0.02	-0.01	0.02	-0.10	-0.01	0.30
Spleen	-0.05	-0.05	0.02	-0.01	-0.01	-0.05	0.00
Thymus	-0.02	-0.01	-0.03	-0.01	-0.09	0.06	0.24

Target	Others ai1	Others Ti2	Others ai2	SI cont Ti1	ULl cont Ti1	LLl cont Ti1	UB cont Ti1
Brain	0.42	0.02	0.27	-0.01	0.02	-0.01	0.04
Breast	0.41	0.06	0.33	0.06	0.03	-0.05	0.07
Colon	0.21	0.02	0.17	0.01	-0.04	0.02	-0.07
Endosteum	0.28	-0.04	0.26	-0.01	-0.06	-0.07	-0.05
Liver	0.02	0.01	-0.01	0.02	-0.02	-0.03	0.01
Lungs	-0.01	0.02	0.00	-0.09	-0.01	-0.05	0.01
Oesophagus	0.41	0.02	0.36	0.00	0.04	0.02	0.11
Red marrow	0.27	0.05	0.34	0.01	0.01	0.05	0.04
Salivary glands	0.48	0.01	0.35	0.07	-0.02	0.02	0.11
Skin	0.43	0.08	0.34	0.04	-0.03	-0.04	0.06
Stomach wall	0.37	0.07	0.27	-0.03	0.04	-0.03	0.04
Testes	0.28	0.04	0.12	0.03	-0.01	-0.08	0.07
Thyroid	0.41	-0.01	0.24	0.00	-0.08	-0.03	0.06
Urinary bladder wall	0.36	0.04	0.32	0.05	0.02	0.06	0.03
Adrenals	0.30	0.01	0.16	0.01	-0.04	0.00	0.02
Extrathoracic airways	0.46	0.04	0.35	0.05	-0.03	-0.03	0.07
Gall bladder wall	0.27	-0.01	0.29	0.09	0.00	0.03	0.00

Heart wall	-0.02	-0.03	0.01	0.02	-0.01	-0.07	0.09
Kidneys	-0.02	0.03	0.04	-0.04	-0.07	-0.01	-0.04
Lymph	0.40	-0.01	0.29	0.05	-0.04	0.06	0.13
Muscle	0.45	0.07	0.29	0.00	-0.01	-0.03	0.07
Oral mucosa	0.41	0.04	0.38	0.00	0.00	-0.06	0.07
Pancreas	0.29	-0.07	0.21	0.00	0.03	0.04	0.06
Prostate	0.19	-0.04	0.20	0.10	0.01	-0.08	0.03
Small intestine wall	0.37	0.01	0.27	0.07	0.03	0.05	0.06
Spleen	0.04	-0.01	0.03	0.04	-0.03	0.02	0.01
Thymus	0.42	0.02	0.35	0.07	-0.01	-0.04	0.08

Ht wall – heart wall; R marrow – red marrow; St wall – stomach wall; SI wall – small intestine wall; Others – other tissue; SI cont – small intestine contents; ULI cont – upper large intestine contents; LLI cont – lower large intestine contents; UB cont – urinary bladder contents

Supplemental Data 9

TABLE 9

Partial rank correlation coefficient between biokinetic parameter and time-integrated activity for ^{18}F-FDG according to the MIRD approach

Parameter	Brain	Heart	Lungs	Liver	Others	Urinary bladder	Blood
Plasma to RBC	-0.17	-0.15	-0.12	-0.12	-0.18	-0.17	0.87
RBC to Plasma	0.06	0.06	0.10	0.09	0.12	0.13	-0.74
Plasma to Urine	-0.10	-0.23	-0.17	-0.05	-0.24	0.91	-0.21
Plasma to WMF	0.46	-0.16	-0.26	-0.09	-0.35	-0.18	-0.23
WMF to Plasma	-0.50	0.26	0.26	0.13	0.37	0.24	0.24
WMF to WMS	0.42	-0.22	-0.22	-0.04	-0.23	-0.25	-0.25
WMS to WMF	-0.18	0.07	0.03	0.04	0.06	0.03	0.05
Plasma to GMF	0.74	-0.36	-0.40	-0.21	-0.55	-0.41	-0.39
GMF to Plasma	-0.82	0.48	0.53	0.21	0.67	0.52	0.55
GMF to GMS	0.60	-0.29	-0.32	-0.13	-0.45	-0.31	-0.34
GMS to GMF	-0.26	0.12	0.15	0.05	0.14	0.17	0.14
Plasma to OtherF	-0.81	-0.80	-0.83	-0.51	0.91	-0.84	-0.82
OtherF to Plasma	0.75	0.73	0.77	0.37	-0.87	0.77	0.76
OtherF to OtherS	-0.72	-0.68	-0.76	-0.39	0.85	-0.76	-0.73
Plasma to LiverF	-0.14	-0.17	-0.13	0.95	-0.26	-0.19	-0.17
LiverF to Plasma	0.07	0.14	0.16	-0.84	0.12	0.20	0.10
LiverF to LiverS	-0.01	-0.14	-0.14	0.84	-0.18	-0.13	-0.19
Plasma to Myocardium	-0.19	0.99	-0.14	-0.06	-0.26	-0.18	-0.17
Plasma to Lungs	0.00	0.00	0.96	-0.01	-0.12	0.03	-0.02

RBC - red blood cells; WMF - white matter fast; WMS - white matter slow; GMF - grey matter fast; GMS - grey matter slow; OtherF – other tissue fast; OtherS - other tissue slow; LiverF - liver fast; LiverS - liver slow

Supplemental Data 10

TABLE 10

Partial rank correlation coefficient between biokinetic parameter and time-integrated activity for ^{18}F-FDG according to the ICRP approach

Source	Brain Fs	Brain Ti1	Heart Fs	Heart Ti1	Lungs Fs	Lungs Ti1	Liver Fs
Brain	1.00	0.01	0.08	-0.02	0.12	-0.13	0.04
Heart wall	0.05	-0.01	1.00	-0.07	-0.02	-0.03	0.00
Lungs	-0.05	0.04	0.03	0.05	1.00	0.01	0.01
Liver	-0.01	-0.01	0.04	-0.01	-0.01	0.13	1.00
Others	-0.84	0.00	-0.57	0.02	-0.49	0.03	-0.69
Urinary bladder	0.02	-0.04	-0.02	-0.03	-0.05	-0.01	0.01

Source	Liver Ti1	Others Ti1	Others ai1	Others Ti2	Others ai2	Others Ti3	Ub cont Ti1
Brain	0.09	0.06	0.05	-0.06	-0.06	-0.06	-0.02
Heart wall	-0.04	0.02	0.07	0.04	-0.07	-0.01	-0.05
Lungs	0.04	0.02	-0.03	0.08	0.02	0.00	0.06
Liver	0.02	0.00	-0.04	0.01	0.04	0.00	0.01
Others	-0.05	0.15	-0.57	0.72	-0.73	-0.02	-0.02
Urinary bladder	0.06	-0.07	0.03	0.02	-0.02	0.06	0.99

Others - other tissue; UB cont - urinary bladder contents

Supplemental Data 11

TABLE 11

Partial rank correlation coefficient between biokinetic parameter and time-integrated activity for ^{99m}Tc-pertechnetate according to the ICRP approach

Source	Thyroid Fs	Thyroid Ti1	Thyroid Ti2	Thyroid ai2	Sgland Fs	Sgland Ti1	Sgland Ti2	Sgland ai2
Thyroid	0.97	0.88	0.54	0.78	-0.06	-0.06	0.05	-0.03
S glands	0.05	0.00	-0.03	-0.03	0.97	0.88	0.56	0.79
St wall	0.03	-0.03	0.04	0.00	0.03	-0.08	0.01	-0.06
ULI wall	0.02	-0.06	-0.05	0.02	0.08	-0.06	0.03	0.02
Others	-0.26	-0.01	-0.02	-0.07	-0.32	0.02	-0.03	0.00
St cont	-0.03	0.04	-0.05	-0.01	0.02	-0.07	0.00	-0.02
SI cont	-0.04	-0.04	-0.07	0.01	0.01	-0.03	-0.06	0.00
ULI cont	0.05	-0.05	-0.05	0.03	0.04	0.02	0.03	0.00
LLI cont	0.01	-0.07	-0.04	0.06	-0.06	0.01	-0.02	0.12
Kidneys	-0.01	0.00	0.06	-0.06	0.03	-0.11	-0.03	0.03
UB cont	-0.11	0.04	-0.01	0.02	-0.07	0.04	0.02	0.02

Source	St wall Fs	St wall Ti1	ULI wall Ti1	ULI wall Tj1	Others Ti1	Others ai1	Others Ti2	Others ai2
Thyroid	0.02	-0.02	0.06	-0.03	0.06	-0.03	0.03	0.01
S glands	-0.06	-0.01	0.05	0.04	0.01	0.01	-0.01	-0.01
St wall	0.96	0.95	-0.01	-0.10	0.07	0.04	-0.06	-0.04
ULI wall	0.00	-0.04	0.95	-0.94	-0.02	0.00	0.08	0.01
Others	-0.93	-0.03	0.03	0.00	0.56	-0.60	0.68	-0.60
St cont	0.05	-0.01	0.07	-0.03	-0.05	-0.01	0.01	0.01
SI cont	-0.08	-0.03	0.03	0.10	-0.04	-0.07	-0.03	0.05
ULI cont	-0.07	-0.09	-0.04	-0.01	-0.05	-0.01	0.01	-0.02
LLI cont	-0.01	-0.05	-0.02	-0.04	0.00	0.05	-0.07	-0.06
Kidneys	0.05	-0.02	0.05	-0.06	-0.09	-0.05	-0.01	0.04
UB cont	-0.05	0.08	0.04	0.03	0.00	0.01	-0.08	-0.04

Source	Others Ti3	St cont Ti1	SI cont Ti1	ULI cont Ti1	LLI cont Ti1	Kidneys Ti1	UB cont Ti1
Thyroid	0.00	0.02	-0.02	0.04	-0.08	-0.03	-0.04
S glands	-0.04	0.05	0.02	-0.02	0.01	-0.04	-0.01
St wall	0.04	0.03	0.03	0.01	-0.06	-0.09	0.03
ULI wall	0.06	0.00	0.03	0.01	-0.06	0.00	-0.01
Others	0.69	-0.06	-0.01	-0.03	0.05	-0.05	-0.04
St cont	-0.02	1.00	-0.01	-0.05	0.01	0.05	0.01
SI cont	-0.03	0.11	0.99	-0.04	0.03	-0.02	-0.05
ULI cont	0.00	0.00	-0.07	1.00	0.00	0.04	0.02
LLI cont	-0.03	-0.04	0.02	0.07	1.00	0.00	-0.02
Kidneys	0.01	0.08	-0.02	-0.02	0.07	1.00	-0.04
UB cont	0.04	0.02	-0.05	0.00	0.03	-0.03	1.00

Sgland – salivary glands; St wall – stomach wall; ULI wall – upper large intestine wall; Others – other tissue; St cont – stomach contents; SI cont – small intestine contents; ULI cont – upper large intestine contents; LLI cont – lower large intestine contents; UB cont – urinary bladder contents

Supplemental Data 12

TABLE 12

Partial rank correlation coefficient between biokinetic parameter and time-integrated activity for ^{99m}Tc-phosphonate according to the ICRP approach

Source	Bone Fs	Bone Ti1	Bone ai1	Bone Ti2	Bone Tj1	Kidneys Fs	Kidneys Ti1	Kidneys ai1
Bone	0.99	0.47	-0.89	0.43	-0.29	0.03	-0.10	0.05
Kidneys	0.01	-0.01	0.02	0.09	-0.04	0.95	0.16	-0.60
UB cont	0.00	0.13	0.05	-0.06	-0.05	0.01	0.11	-0.02
Others	-1.00	0.02	0.01	-0.08	-0.03	-0.58	-0.02	-0.02

Source	Kidneys Ti2	Kidneys ai2	Kidneys Ti3	UB cont Ti1	Others Ti1
Bone	-0.06	-0.05	0.06	-0.01	-0.03
Kidneys	0.32	-0.53	0.18	-0.01	0.05
UB cont	-0.03	0.02	-0.05	1.00	0.01
Others	-0.05	0.00	0.00	-0.03	0.88

UB cont – urinary bladder contents; Others – other tissue

Supplemental Data 13

TABLE 13

Partial rank correlation coefficient between biokinetic parameter and time-integrated activity for ^{99m}Tc-sestamibi according to the ICRP approach

Source	Ht wall Fs	Ht wall Ti1	Ht wall Ti2	Ht wall ai2	Kidneys Fs	Kidneys Ti1	Muscles Fs	Muscles Ti1
Ht wall	0.98	0.84	0.42	0.76	0.06	-0.07	0.01	0.00
Kidneys	0.01	0.04	-0.07	0.06	0.98	0.92	0.01	0.01
Muscles	-0.01	-0.04	-0.03	0.05	0.10	0.00	0.99	0.88
S glands	0.03	0.05	-0.01	-0.03	0.01	-0.02	-0.05	0.00
Thyroid	0.00	0.04	-0.06	0.01	0.11	0.09	0.04	-0.11
Others	-0.17	0.06	0.02	-0.01	-0.86	0.05	-0.93	-0.02
Liver	-0.02	0.12	0.02	-0.05	0.10	-0.04	0.05	-0.03
GB cont	0.01	0.02	0.07	0.03	-0.01	0.03	-0.02	0.01
SI cont	-0.03	-0.07	0.04	-0.08	0.00	0.05	0.02	0.03
ULI cont	-0.03	-0.03	-0.06	-0.04	-0.01	-0.01	-0.01	0.06
LLI cont	-0.08	-0.01	0.02	0.06	0.03	-0.04	-0.03	-0.05
UB cont	-0.01	0.01	-0.03	0.11	-0.02	0.11	0.01	0.09

Source	S glands Fs	S glands Ti1	Thyroid Fs	Thyroid Ti1	Others Ti1	Liver Fs	Liver Ti1	Liver Ti2
Ht wall	0.06	-0.02	0.02	0.06	0.00	-0.04	-0.01	0.02
Kidneys	-0.06	0.07	-0.03	0.01	0.07	-0.07	0.17	-0.04
Muscles	0.05	-0.06	0.01	0.05	0.05	-0.01	-0.02	0.00
S glands	0.99	0.88	0.00	-0.01	0.09	0.06	-0.04	0.02
Thyroid	0.03	0.05	0.88	0.83	0.06	0.03	0.00	0.02
Others	-0.18	-0.06	0.05	-0.04	0.73	-0.91	0.07	0.09
Liver	0.01	-0.01	0.01	0.04	0.03	0.98	0.89	0.32
GB cont	0.00	-0.02	0.18	-0.06	-0.01	0.06	0.12	-0.05
SI cont	-0.02	0.03	0.00	0.10	-0.05	0.02	0.04	0.08
ULI cont	-0.05	0.00	-0.03	-0.08	0.05	0.00	-0.05	0.05
LLI cont	-0.09	0.05	0.00	0.05	-0.05	-0.04	-0.03	0.06
UB cont	-0.03	-0.01	0.00	-0.10	-0.05	0.00	0.06	0.01

Source	Liver ai2	GB cont Ti1	SI cont Ti1	ULI cont Ti1	LLI cont Ti1	UB cont Ti1
Ht wall	0.02	0.00	-0.06	0.03	-0.07	0.00
Kidneys	0.00	-0.07	0.07	0.00	-0.07	-0.03
Muscles	-0.04	-0.01	-0.08	0.00	0.01	0.06
S glands	0.04	0.02	0.06	0.01	0.01	0.03
Thyroid	0.04	0.08	0.06	-0.04	-0.07	0.08
Others	0.00	-0.01	0.04	-0.01	0.10	-0.04
Liver	0.82	0.01	0.03	-0.08	0.07	0.02
GB cont	-0.03	1.00	0.02	-0.05	0.03	0.02
SI cont	-0.04	-0.02	1.00	0.02	0.10	0.02
ULI cont	0.02	-0.02	-0.01	1.00	-0.05	-0.02
LLI cont	0.03	-0.03	-0.05	-0.02	1.00	0.02
UB cont	0.01	0.06	0.01	0.05	-0.01	1.00

Ht wall – heart wall; S glands – salivary glands; Others – other tissue; GB cont – gall bladder contents;
SI cont – small intestine contents; ULI cont – upper large intestine contents;
LLI cont – lower large intestine contents; UB cont – urinary bladder contents

Supplemental Data 14

TABLE 14

Partial rank correlation coefficient between biokinetic parameter and time-integrated activity for ^{99m}Tc-tetrofosmin according to the ICRP approach

Source	Ht wall Fs	Ht wall Ti1	Ht wall Ti2	Ht wall ai2	Liver Fs	Liver Ti1	Liver Ti2	Liver ai2
Ht wall	0.98	0.84	0.46	0.78	-0.12	0.08	-0.01	-0.02
Liver	-0.05	0.03	0.00	0.04	0.96	0.91	0.69	0.70
Kidneys	0.01	0.03	-0.05	0.01	0.01	0.07	0.01	0.04
S glands	-0.03	0.05	0.12	-0.07	0.05	-0.10	-0.01	0.03
Thyroid	-0.02	0.04	0.09	-0.02	0.00	-0.05	-0.04	-0.05
Others	-0.07	-0.03	0.02	-0.08	-0.84	0.02	-0.04	0.02
GB cont	0.01	-0.04	0.07	0.03	-0.02	-0.02	0.09	0.00
SI cont	0.01	0.03	0.05	0.02	0.00	-0.09	0.00	-0.03
ULI cont	-0.05	-0.02	0.01	0.04	0.00	-0.03	0.03	-0.06
LLI cont	0.02	0.10	-0.04	0.09	0.02	0.03	0.02	-0.03
UB cont	-0.05	-0.07	-0.03	0.01	0.00	-0.03	-0.02	-0.04

Source	Kidneys Fs	Kidneys Ti1	Kidneys Ti2	Kidneys ai2	S glands Fs	S glands Ti1	Thyroid Fs	Thyroid Ti1
Ht wall	0.04	0.02	0.01	0.03	-0.01	0.01	0.02	-0.04
Liver	-0.01	0.04	-0.02	-0.03	-0.03	0.05	0.04	0.04
Kidneys	0.97	0.70	0.55	0.92	-0.05	0.03	-0.08	-0.07
S glands	0.00	0.01	0.09	-0.06	1.00	0.90	-0.01	0.04
Thyroid	-0.04	-0.05	0.06	0.03	-0.01	0.01	0.89	0.82
Others	-0.73	-0.02	-0.02	-0.06	-0.18	0.09	-0.06	-0.05
GB cont	-0.03	0.04	0.05	0.07	0.05	-0.01	0.00	0.07
SI cont	-0.01	0.06	-0.02	-0.05	0.00	0.01	0.04	0.04
ULI cont	-0.02	0.05	-0.01	0.01	-0.12	0.03	0.00	-0.01
LLI cont	0.00	-0.02	-0.03	-0.02	0.00	-0.02	-0.06	-0.01
UB cont	0.03	-0.06	-0.09	-0.03	-0.08	0.01	-0.10	-0.04

Source	Others Ti1	Others ai1	Others Ti2	GB cont Ti1	SI cont Ti1	ULI cont Ti1	LLI cont Ti1	UB cont Ti1
Ht wall	0.00	-0.08	0.06	0.00	-0.04	0.01	0.01	-0.03
Liver	0.05	-0.06	0.06	-0.03	-0.03	0.07	-0.04	-0.08
Kidneys	0.04	0.09	0.00	0.01	-0.08	0.02	-0.01	0.01
S glands	0.04	0.01	-0.02	-0.03	0.02	0.00	0.02	-0.06
Thyroid	0.06	-0.07	0.03	-0.01	-0.03	0.00	-0.06	0.02
Others	0.15	-0.89	0.92	0.03	-0.01	0.00	0.04	0.01
GB cont	0.03	-0.01	0.00	0.98	0.03	0.07	-0.05	0.13
SI cont	-0.01	0.02	0.01	-0.04	1.00	0.01	0.02	-0.01
ULI cont	-0.04	-0.05	0.04	0.01	0.06	1.00	0.02	-0.04
LLI cont	0.00	-0.02	-0.04	-0.04	-0.07	-0.02	1.00	0.03

UB cont	-0.09	-0.08	-0.01	-0.03	0.02	0.06	0.07	1.00

Ht wall – heart wall; S glands – salivary glands; Others – other tissue; GB cont – gall bladder contents;
SI cont – small intestine contents; ULI cont – upper large intestine contents;
LLI cont – lower large intestine contents; UB cont – urinary bladder contents

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TABLE 15

Partial rank correlation coefficient between biokinetic parameter and time-integrated activity for ^{99m}Tc-MAA according to the ICRP approach

Source	Lungs Ti1	Lungs Ti2	Lungs ai2	Liver Fs	Liver Ti1	Liver Tj1	Kidneys Ti1	UB cont Ti1	Others Ti1
Lungs	0.99	0.31	0.89	0.05	0.02	-0.02	-0.06	-0.05	-0.04
Liver	0.02	0.01	0.03	0.98	0.20	-0.92	0.04	-0.09	-0.03
Kidneys	-0.09	-0.02	0.02	0.01	0.06	-0.06	0.97	-0.03	0.01
Urinary bladder	0.06	-0.07	-0.01	0.01	0.06	-0.05	-0.07	0.99	-0.03
Other	0.02	-0.04	-0.04	-0.99	-0.04	0.00	-0.01	-0.07	0.92

UB cont – urinary bladder contents; Others – other tissue

Supplemental Data 16

TABLE 16

Partial rank correlation coefficient between biokinetic parameter and time-integrated activity for ^{201}Tl-chloride according to the ICRP approach

Source	Bone Fs	Bone Ti1	Bone Ti2	Bone ai2	Thyroid Fs	Thyroid Ti1	Thyroid Ti2
Bone	1.00	0.87	0.44	0.73	0.05	0.01	-0.02
Thyroid	-0.03	0.00	0.06	-0.02	1.00	0.88	0.48
Ht wall	-0.03	-0.02	-0.05	0.00	-0.05	0.06	-0.04
Lungs	0.08	-0.01	0.05	0.00	-0.04	-0.06	0.08
Kidneys	-0.09	-0.04	0.07	-0.01	-0.04	-0.09	-0.10
Liver	0.02	0.02	-0.02	-0.09	-0.01	-0.02	-0.02
Spleen	0.03	0.03	-0.01	0.07	0.00	0.09	-0.01
R marrow	0.04	0.00	-0.01	0.00	-0.08	0.07	-0.02
St wall	-0.07	-0.04	-0.06	0.05	-0.05	-0.01	-0.07
SI wall	-0.01	-0.05	0.03	-0.03	0.01	-0.03	0.10
Muscles	-0.01	-0.02	-0.05	-0.05	0.03	-0.06	0.02
Testes	-0.05	0.11	0.04	0.00	0.02	0.00	0.04
Others	-0.53	-0.02	-0.09	0.03	-0.01	0.04	0.01
SI cont	0.00	0.01	0.13	-0.03	-0.04	-0.01	-0.13
ULI cont	0.06	0.02	0.01	0.06	-0.02	-0.14	-0.07
LLI cont	0.00	-0.04	0.03	0.02	0.06	0.02	-0.01
UB cont	-0.03	0.00	0.01	0.05	0.01	-0.07	-0.11

Source	Thyroid ai2	Ht wall Fs	Ht wall Ti1	Ht wall Ti2	Ht wall ai2	Ht wall Ti3	Ht wall ai3	Lungs Fs	Lungs Ti1
Bone	-0.03	-0.06	-0.04	-0.02	0.01	-0.02	0.02	-0.02	0.07
Thyroid	0.71	-0.06	0.02	0.00	0.02	-0.03	-0.01	0.12	-0.01
Ht wall	0.00	0.97	0.43	0.55	0.58	0.05	0.47	-0.06	-0.02
Lungs	0.02	0.05	0.08	0.04	-0.11	-0.02	0.11	1.00	0.86
Kidneys	0.05	0.02	0.07	-0.07	0.08	0.00	-0.07	0.06	0.07
Liver	0.01	-0.09	-0.03	-0.07	-0.07	0.04	0.09	-0.09	0.10
Spleen	-0.13	-0.01	-0.07	0.01	-0.06	0.05	0.05	-0.01	-0.04
R marrow	0.03	-0.01	0.03	0.05	0.06	-0.07	-0.04	-0.03	0.01
St wall	-0.04	0.02	0.00	0.05	-0.02	-0.02	0.04	-0.03	-0.03
SI wall	-0.02	0.00	-0.06	-0.04	0.00	-0.05	-0.03	0.10	-0.03
Muscles	-0.06	-0.02	-0.03	0.00	0.06	-0.02	-0.03	0.01	0.00
Testes	0.02	-0.08	0.01	0.07	-0.09	-0.01	0.10	0.01	-0.01
Others	0.01	-0.41	-0.04	0.08	0.05	0.00	-0.07	-0.37	0.05
SI cont	-0.03	-0.03	0.00	-0.03	-0.02	-0.02	0.07	-0.06	0.07
ULI cont	-0.06	-0.07	-0.01	0.07	-0.09	0.00	0.09	0.03	0.03
LLI cont	0.02	0.07	-0.09	-0.05	0.00	0.06	-0.02	0.13	-0.02
UB cont	-0.03	-0.05	0.08	0.07	-0.07	0.00	0.03	0.00	-0.05

Source	Lungs Ti2	Lungs ai2	Kidneys Fs	Kidneys Ti1	Kidneys Ti2	Kidneys ai2	Liver Fs	Liver Ti1
Bone	-0.05	-0.08	0.08	0.07	-0.08	0.00	0.01	0.00
Thyroid	0.01	0.01	0.05	-0.06	0.06	0.02	0.02	0.10
Ht wall	0.04	0.00	-0.03	0.09	0.04	0.02	0.04	0.05
Lungs	0.34	0.69	-0.08	-0.05	0.13	-0.03	-0.01	-0.07
Kidneys	0.02	0.06	1.00	0.87	0.39	0.68	-0.08	0.06
Liver	0.06	0.00	0.05	0.03	0.01	0.01	1.00	0.87
Spleen	0.00	0.02	0.06	-0.07	0.03	0.01	-0.06	-0.01
R marrow	-0.01	-0.02	-0.01	-0.07	0.01	-0.07	-0.01	-0.07
St wall	0.03	-0.03	0.00	-0.03	-0.03	0.03	0.10	-0.01
SI wall	-0.03	-0.02	-0.02	-0.07	0.06	0.04	-0.02	0.02
Muscles	-0.07	0.05	-0.07	-0.03	-0.03	0.03	-0.02	0.01
Testes	0.01	0.01	-0.04	-0.04	-0.09	0.09	0.05	0.02
Others	-0.02	0.01	-0.54	0.02	-0.01	-0.02	-0.71	-0.09
SI cont	0.00	0.10	0.05	0.00	0.05	-0.01	0.01	-0.01
ULI cont	0.11	0.13	0.05	-0.07	0.03	0.08	-0.01	-0.06
LLI cont	0.01	0.02	0.02	0.05	0.07	0.07	0.01	-0.05
UB cont	0.02	0.05	-0.01	0.05	-0.10	0.06	0.05	-0.03

Source	Liver Ti2	Liver ai2	Spleen Fs	Spleen Ti1	Spleen Ti2	Spleen ai2	R marrow Fs	R marrow Ti1
Bone	-0.01	-0.03	-0.04	-0.06	0.05	-0.04	-0.05	0.03
Thyroid	0.01	0.01	0.01	0.04	-0.02	-0.04	-0.03	-0.07
Ht wall	-0.04	-0.01	-0.01	0.03	0.04	0.04	0.05	-0.06
Lungs	0.04	-0.01	0.00	-0.02	-0.04	-0.01	-0.03	0.00
Kidneys	-0.10	-0.04	-0.01	0.05	0.00	-0.03	0.00	-0.09
Liver	0.37	0.69	-0.08	0.00	0.02	-0.08	-0.01	-0.01
Spleen	0.04	-0.02	1.00	0.88	0.42	0.72	0.08	-0.09
R marrow	0.07	0.05	0.00	-0.05	0.02	0.02	1.00	0.88
St wall	0.06	0.08	0.00	-0.05	-0.03	0.01	0.04	-0.07
SI wall	0.01	0.01	-0.03	0.06	0.06	-0.01	-0.02	0.08
Muscles	0.03	-0.03	0.05	-0.04	0.05	0.02	-0.04	-0.03
Testes	-0.02	-0.04	-0.04	0.00	0.05	0.05	0.01	-0.04
Others	0.00	0.09	-0.11	0.04	0.06	0.03	-0.57	-0.02
SI cont	0.03	-0.09	0.01	-0.02	0.00	-0.03	0.01	-0.06
ULI cont	-0.01	-0.01	-0.03	0.00	0.02	-0.06	0.01	-0.01
LLI cont	0.03	0.06	0.00	-0.04	-0.07	-0.02	-0.13	0.04
UB cont	-0.01	-0.01	0.05	-0.05	-0.11	0.01	0.03	-0.05

Source	R marrow Ti2	R marrow ai2	St wall Fs	St wall Ti1	St wall Ti2	St wall ai2	SI wall Fs	SI wall Ti1
Bone	-0.03	-0.01	-0.03	0.01	0.03	-0.03	0.04	-0.03
Thyroid	-0.03	-0.02	0.01	0.00	0.07	-0.04	0.00	0.04
Ht wall	0.01	-0.07	0.01	-0.04	0.02	-0.10	0.05	-0.03

Lungs	-0.05	0.04	0.06	0.10	-0.05	0.00	0.10	-0.06
Kidneys	0.03	0.03	0.04	-0.06	-0.02	-0.01	0.04	0.01
Liver	0.01	0.00	0.03	0.08	-0.05	0.00	-0.04	-0.03
Spleen	-0.07	-0.06	-0.13	0.00	-0.01	0.12	-0.06	-0.03
R marrow	0.39	0.73	-0.11	0.02	-0.08	-0.05	0.05	-0.08
St wall	-0.02	0.00	1.00	0.88	0.37	0.70	0.00	0.04
SI wall	-0.07	-0.01	0.02	0.08	-0.08	-0.06	0.99	0.86
Muscles	0.01	-0.02	0.02	-0.04	0.04	0.07	0.02	-0.05
Testes	0.10	-0.08	-0.05	-0.02	-0.03	-0.01	-0.03	0.06
Others	0.03	0.06	-0.07	-0.02	-0.02	0.02	-0.34	0.02
SI cont	0.06	-0.02	0.05	0.06	0.06	0.01	0.04	-0.09
ULI cont	-0.02	-0.10	0.04	-0.01	-0.01	-0.04	-0.01	-0.02
LLI cont	0.05	0.07	0.01	-0.08	-0.03	-0.03	0.02	0.03
UB cont	0.04	0.06	0.04	0.06	0.02	-0.01	-0.01	0.00

Source	SI wall Ti2	SI wall ai2	Muscles Fs	Muscles Ti1	Muscles Ti2	Muscles ai2	Testes Fs	Testes Ti1	Testes Ti2
Bone	-0.02	-0.03	-0.01	0.03	-0.01	0.07	0.03	-0.04	0.01
Thyroid	0.04	-0.04	0.04	0.04	-0.04	0.00	0.01	0.05	0.07
Ht wall	0.07	0.02	0.01	0.04	-0.01	-0.03	-0.03	-0.01	0.07
Lungs	0.02	-0.01	-0.02	0.00	-0.05	-0.09	-0.04	-0.05	0.00
Kidneys	-0.03	0.03	0.00	-0.12	0.04	-0.04	-0.04	0.02	-0.02
Liver	-0.02	0.07	0.11	0.03	-0.04	-0.02	0.09	0.01	-0.02
Spleen	0.00	-0.05	0.04	0.07	0.07	0.01	-0.01	0.00	-0.03
R marrow	-0.05	-0.02	0.03	-0.06	-0.01	0.02	0.00	-0.10	0.03
St wall	0.03	-0.04	0.04	0.02	-0.07	-0.06	0.04	0.02	-0.03
SI wall	0.39	0.70	0.03	0.06	0.04	-0.06	0.00	-0.03	0.03
Muscles	0.05	0.12	0.99	0.84	0.39	0.66	0.03	0.06	-0.06
Testes	0.06	0.01	0.06	0.06	0.01	-0.01	0.99	0.86	0.40
Others	0.03	0.06	-0.98	-0.01	-0.02	-0.01	0.02	-0.01	-0.12
SI cont	-0.05	-0.05	-0.09	-0.03	-0.03	0.00	-0.02	0.08	-0.02
ULI cont	0.03	0.04	0.02	0.03	0.03	0.08	0.09	0.03	-0.03
LLI cont	-0.04	0.03	-0.01	-0.04	-0.01	0.03	0.09	0.04	0.03
UB cont	-0.03	0.03	-0.11	0.06	-0.04	0.04	0.03	0.02	0.09

Source	Testes ai2	Others Ti1	Others ai1	Others Ti2	Others ai2	SI cont Ti1	ULI cont Ti1	LLI cont Ti1	UB cont Ti1
Bone	0.04	0.03	0.01	-0.05	0.01	-0.16	0.01	-0.04	-0.04
Thyroid	-0.03	-0.03	0.06	-0.06	-0.05	0.01	-0.05	-0.02	-0.02
Ht wall	-0.05	-0.02	-0.09	-0.06	0.10	-0.06	0.02	0.07	0.14
Lungs	0.01	0.00	0.05	-0.04	-0.04	-0.02	0.00	0.01	-0.03
Kidneys	0.00	0.04	-0.03	0.06	0.01	-0.02	-0.04	-0.05	0.00
Liver	-0.08	0.05	0.00	-0.01	0.02	-0.01	0.07	0.00	0.01
Spleen	-0.03	-0.02	0.03	-0.04	-0.03	0.06	0.02	0.00	-0.08
R marrow	0.09	-0.07	-0.08	-0.01	0.08	0.00	-0.03	-0.10	-0.06
St wall	-0.06	0.00	0.01	0.01	-0.05	-0.01	-0.07	0.06	0.01

SI wall	0.05	0.01	-0.04	0.05	0.03	0.01	0.04	0.01	0.05
Muscles	0.02	-0.07	0.04	-0.04	-0.06	0.00	-0.01	-0.06	-0.02
Testes	0.67	-0.01	0.00	-0.07	-0.02	-0.02	0.03	0.03	0.03
Others	0.03	0.31	0.48	0.05	0.39	0.05	-0.03	-0.02	0.09
SI cont	-0.09	-0.01	-0.07	0.09	0.07	1.00	0.00	-0.04	-0.01
ULI cont	-0.06	0.04	-0.11	0.17	0.11	-0.05	1.00	0.02	0.00
LLI cont	-0.10	0.00	0.09	-0.02	-0.06	0.07	0.03	1.00	0.04
UB cont	-0.05	0.04	-0.05	-0.08	0.03	0.06	0.01	-0.03	1.00

Ht wall – heart wall; R marrow – red marrow; St wall – stomach wall; SI wall – small intestine wall; Others – other tissue; SI cont – small intestine contents; ULI cont – upper large intestine contents; LLI cont – lower large intestine contents; UB cont – urinary bladder contents

Supplemental Data 17

TABLE 17

Total-effect index for biokinetic parameters and S values for ^{99m}Tc-pertechnetate according to the ICRP method

Target	Parameter	S value
Brain	32.6%	73.8%
Breast	17.7%	87.4%
Colon	6.9%	102.8%
Endosteum	6.7%	87.1%
Liver	9.9%	83.5%
Lungs	54.7%	36.8%
Oesophagus	24.1%	68.7%
Red marrow	22.3%	72.8%
Salivary glands	35.7%	62.0%
Skin	37.9%	66.9%
Stomach wall	29.7%	73.4%
Testes	17.6%	86.7%
Thyroid	95.0%	9.7%
Urinary bladder wall	4.2%	96.5%
Adrenals	6.7%	93.9%
Extrathoracic airways	25.6%	70.8%
Gall bladder wall	1.5%	96.5%
Heart wall	33.1%	64.8%
Kidneys	6.2%	92.3%
Lymph	15.1%	85.1%
Muscle	17.9%	78.9%
Oral mucosa	31.9%	74.5%
Pancreas	2.9%	97.7%
Prostate	25.7%	74.1%
Small intestine wall	8.1%	89.3%
Spleen	9.0%	84.6%
Thymus	9.9%	87.3%

Supplemental Data 18

TABLE 18

Total-effect index for biokinetic parameters and S values for ^{99m}Tc-phosphonate according to the ICRP method

Target	Parameter	S value
Brain	12.7%	97.8%
Breast	19.7%	87.5%
Colon	14.3%	97.9%
Endosteum	38.3%	61.2%
Liver	11.6%	97.1%
Lungs	10.0%	84.5%
Oesophagus	13.4%	99.6%
Red marrow	13.4%	101.9%
Salivary glands	52.8%	48.9%
Skin	13.0%	98.1%
Stomach wall	15.5%	89.9%
Testes	28.1%	80.0%
Thyroid	12.8%	97.4%
Urinary bladder wall	4.5%	90.3%
Adrenals	18.3%	99.5%
Extrathoracic airways	56.2%	44.6%
Gall bladder wall	14.5%	92.1%
Heart wall	13.7%	88.3%
Kidneys	25.6%	83.7%
Lymph	17.9%	80.8%
Muscle	10.4%	86.7%
Oral mucosa	73.0%	35.3%
Pancreas	16.1%	89.4%
Prostate	24.5%	79.7%
Small intestine wall	9.0%	93.9%
Spleen	14.3%	82.6%
Thymus	13.5%	98.7%

Supplemental Data 19

TABLE 19

Total-effect index for biokinetic parameters and S values for ^{99m}Tc-sestamibi according to the ICRP method

Target	Parameter	S value
Brain	94.0%	11.8%
Breast	24.4%	83.7%
Colon	11.5%	92.0%
Endosteum	4.6%	102.9%
Liver	50.6%	48.2%
Lungs	37.7%	69.7%
Oesophagus	28.8%	66.3%
Red marrow	12.9%	84.9%
Salivary glands	34.4%	65.6%
Skin	19.7%	77.1%
Stomach wall	3.7%	99.3%
Testes	19.7%	78.4%
Thyroid	53.6%	45.1%
Urinary bladder wall	2.4%	101.9%
Adrenals	19.0%	69.3%
Extrathoracic airways	30.2%	71.5%
Gall bladder wall	0.6%	103.3%
Heart wall	39.1%	66.2%
Kidneys	63.5%	34.1%
Lymph	22.5%	75.1%
Muscle	9.0%	86.8%
Oral mucosa	25.5%	76.9%
Pancreas	3.7%	93.9%
Prostate	12.8%	89.2%
Small intestine wall	17.0%	86.3%
Spleen	22.3%	81.0%
Thymus	36.1%	68.8%

Supplemental Data 20

TABLE 20

Total-effect index for biokinetic parameters and S values for ^{99m}Tc-tetrofosmin according to the ICRP method

Target	Parameter	S value
Brain	16.6%	80.5%
Breast	9.2%	93.5%
Colon	6.1%	89.3%
Endosteum	3.1%	92.8%
Liver	8.1%	85.7%
Lungs	46.3%	56.6%
Oesophagus	13.1%	89.3%
Red marrow	14.5%	90.4%
Salivary glands	33.8%	70.2%
Skin	23.5%	76.1%
Stomach wall	1.6%	92.8%
Testes	9.0%	87.2%
Thyroid	58.0%	41.2%
Urinary bladder wall	2.0%	100.0%
Adrenals	6.2%	98.4%
Extrathoracic airways	14.9%	83.3%
Gall bladder wall	0.2%	98.5%
Heart wall	39.4%	64.7%
Kidneys	29.7%	67.5%
Lymph	18.1%	80.0%
Muscle	8.9%	89.9%
Oral mucosa	17.7%	92.0%
Pancreas	0.9%	101.6%
Prostate	15.4%	82.5%
Small intestine wall	7.7%	88.9%
Spleen	6.9%	95.6%
Thymus	21.5%	80.0%

Supplemental Data 21

TABLE 21

Total-effect index for biokinetic parameters and S values for ^{99m}Tc-MAA according to the ICRP method

Target	Parameter	S value
Brain	8.2%	88.2%
Breast	1.6%	97.6%
Colon	3.2%	96.8%
Endosteum	1.3%	100.1%
Liver	19.9%	80.3%
Lungs	2.6%	94.7%
Oesophagus	1.8%	98.5%
Red marrow	1.4%	91.1%
Salivary glands	1.6%	93.3%
Skin	1.2%	92.7%
Stomach wall	4.5%	96.4%
Testes	12.0%	87.0%
Thyroid	1.3%	99.3%
Urinary bladder wall	8.7%	93.4%
Adrenals	7.7%	94.7%
Extrathoracic airways	2.4%	105.9%
Gall bladder wall	28.9%	66.1%
Heart wall	1.6%	98.0%
Kidneys	7.0%	89.9%
Lymph	10.5%	87.9%
Muscle	1.4%	98.6%
Oral mucosa	8.5%	102.7%
Pancreas	9.5%	92.8%
Prostate	37.9%	65.0%
Small intestine wall	5.1%	89.7%
Spleen	1.0%	100.1%
Thymus	1.0%	98.4%

Supplemental Data 22

TABLE 22

Total-effect index for biokinetic parameters and S values for ^{201}Tl-chloride according to the ICRP method

Target	Parameter	S value
Brain	100.5%	0.9%
Breast	98.5%	4.3%
Colon	73.4%	29.9%
Endosteum	47.5%	50.8%
Liver	59.8%	43.5%
Lungs	75.8%	31.3%
Oesophagus	89.4%	13.0%
Red marrow	67.1%	31.8%
Salivary glands	98.4%	0.9%
Skin	101.3%	1.5%
Stomach wall	9.6%	91.7%
Testes	52.2%	46.3%
Thyroid	29.1%	67.5%
Urinary bladder wall	75.9%	22.5%
Adrenals	48.9%	53.7%
Extrathoracic airways	95.7%	3.7%
Gall bladder wall	48.6%	45.5%
Heart wall	32.0%	69.8%
Kidneys	45.4%	52.9%
Lymph	88.2%	14.9%
Muscle	41.4%	59.1%
Oral mucosa	99.8%	0.9%
Pancreas	63.4%	41.5%
Prostate	71.9%	28.8%
Small intestine wall	5.3%	97.1%
Spleen	86.7%	11.0%
Thymus	76.9%	24.5%

Supplemental Data 23

TABLE 23
Total-effect index for biokinetic parameters
for 18F-FDG according to the MIRD approach

Target	Plasma to RBC	RBC to Plasma	Plasma to Urine	Plasma to WMF	WMF to Plasma	WMF to WMS	WMS to WMF
Brain	0.2%	0.2%	0.3%	2.5%	3.2%	2.2%	0.3%
Breast	0.8%	0.8%	1.5%	2.2%	2.7%	1.9%	0.2%
Colon	1.1%	1.1%	5.3%	2.5%	3.1%	2.1%	0.3%
Endosteum	0.2%	0.2%	0.1%	0.2%	0.2%	0.1%	0.0%
Liver	0.2%	0.2%	0.1%	0.2%	0.2%	0.1%	0.0%
Lungs	3.2%	3.2%	0.5%	0.9%	1.2%	0.8%	0.1%
Oesophagus	11.2%	11.2%	0.8%	1.3%	1.6%	1.1%	0.1%
Red marrow	0.0%	0.0%	0.1%	0.5%	0.6%	0.4%	0.1%
Salivary glands	0.1%	0.1%	2.0%	2.0%	2.5%	1.7%	0.2%
Skin	0.1%	0.1%	0.2%	0.6%	0.8%	0.6%	0.1%
Stomach wall	2.6%	2.6%	0.7%	2.0%	2.5%	1.7%	0.2%
Testes	0.0%	0.0%	1.3%	1.7%	2.1%	1.4%	0.2%
Thyroid	10.3%	10.3%	1.8%	1.1%	1.4%	0.9%	0.1%
Urinary bladder wall	0.1%	0.1%	22.9%	0.4%	0.5%	0.3%	0.0%
Adrenals	4.1%	4.1%	0.3%	1.8%	2.1%	1.5%	0.2%
Extrathoracic airways	0.1%	0.1%	1.1%	3.0%	3.8%	2.6%	0.3%
Gall bladder wall	0.7%	0.7%	0.1%	0.8%	0.9%	0.6%	0.1%
Heart wall	0.1%	0.1%	0.1%	0.2%	0.3%	0.2%	0.0%
Kidneys	3.0%	3.0%	0.6%	2.0%	2.5%	1.8%	0.2%
Lymph	0.4%	0.4%	4.3%	3.5%	4.3%	3.0%	0.4%
Muscle	0.0%	0.0%	0.0%	1.2%	1.5%	1.1%	0.1%
Oral mucosa	0.2%	0.2%	0.5%	1.4%	1.8%	1.3%	0.1%
Pancreas	3.8%	3.8%	0.4%	2.0%	2.5%	1.8%	0.2%
Prostate	0.1%	0.1%	46.4%	1.8%	2.2%	1.5%	0.2%
Small intestine wall	2.0%	2.0%	1.8%	2.2%	2.7%	1.9%	0.2%
Spleen	5.7%	5.7%	0.3%	1.7%	2.1%	1.4%	0.2%
Thymus	5.2%	5.2%	0.9%	1.3%	1.6%	1.1%	0.1%

Target	Plasma to GMF	GMF to Plasma	GMF to GMS	WMS to WMF	Plasma to Fast OT	Fast OT to Plasma
Brain	11.4%	18.8%	5.5%	0.6%	15.6%	10.1%
Breast	10.0%	16.7%	4.8%	0.6%	15.0%	9.8%
Colon	10.8%	18.5%	5.2%	0.6%	3.7%	2.5%
Endosteum	0.6%	1.0%	0.3%	0.0%	6.6%	4.1%
Liver	0.6%	1.1%	0.3%	0.0%	3.1%	1.9%

Lungs	4.0%	6.8%	2.0%	0.2%	15.3%	10.0%
Oesophagus	5.7%	9.5%	2.8%	0.3%	6.1%	3.6%
Red marrow	2.1%	3.4%	1.0%	0.1%	6.2%	4.4%
Salivary glands	9.1%	15.1%	4.4%	0.5%	5.5%	3.4%
Skin	2.7%	4.6%	1.3%	0.2%	17.3%	11.0%
Stomach wall	8.8%	14.7%	4.3%	0.5%	2.7%	1.7%
Testes	7.5%	12.5%	3.6%	0.4%	21.9%	13.6%
Thyroid	4.6%	7.8%	2.3%	0.3%	1.4%	0.8%
Urinary bladder wall	1.5%	2.7%	0.7%	0.1%	8.5%	5.4%
Adrenals	7.6%	12.5%	3.7%	0.4%	1.2%	0.6%
Extrathoracic airways	13.1%	21.9%	6.4%	0.7%	12.0%	7.9%
Gall bladder wall	3.1%	5.2%	1.5%	0.2%	0.9%	0.5%
Heart wall	1.2%	1.7%	0.5%	0.1%	4.0%	2.8%
Kidneys	8.9%	14.8%	4.3%	0.5%	2.5%	1.6%
Lymph	15.3%	25.6%	7.3%	0.9%	8.5%	5.4%
Muscle	5.6%	9.2%	2.6%	0.3%	21.7%	14.0%
Oral mucosa	6.2%	10.4%	2.9%	0.3%	5.0%	3.1%
Pancreas	8.8%	14.9%	4.4%	0.5%	2.8%	1.9%
Prostate	7.8%	12.7%	3.6%	0.4%	5.0%	3.7%
Small intestine wall	9.9%	16.3%	4.7%	0.5%	5.9%	3.4%
Spleen	7.5%	12.1%	3.5%	0.4%	1.9%	1.3%
Thymus	6.1%	9.9%	2.9%	0.3%	1.4%	1.0%

Target	Fast OT to Slow OT	Plasma to Fast Liver	Fast Liver to Plasma	Fast Liver to Liver "Sink"	Plasma to Myocardium	Plasma to Lungs
Brain	9.3%	0.4%	0.1%	0.1%	0.3%	0.0%
Breast	9.1%	0.4%	0.1%	0.1%	7.5%	0.2%
Colon	2.3%	0.4%	0.1%	0.1%	0.7%	0.1%
Endosteum	3.7%	0.7%	0.2%	0.2%	0.5%	0.0%
Liver	1.7%	49.5%	14.5%	15.9%	0.1%	0.0%
Lungs	9.0%	0.2%	0.0%	0.0%	2.5%	26.5%
Oesophagus	3.4%	0.3%	0.1%	0.1%	13.2%	0.2%
Red marrow	3.7%	0.3%	0.1%	0.1%	0.2%	0.0%
Salivary glands	3.5%	2.5%	0.7%	0.8%	1.6%	0.1%
Skin	10.8%	0.4%	0.1%	0.1%	0.4%	0.0%
Stomach wall	1.8%	6.2%	1.7%	1.8%	10.3%	0.0%
Testes	12.6%	1.3%	0.4%	0.4%	1.1%	0.1%
Thyroid	0.8%	1.4%	0.4%	0.5%	0.1%	0.1%
Urinary bladder wall	4.8%	0.3%	0.1%	0.1%	0.2%	0.0%
Adrenals	0.6%	22.5%	6.3%	6.8%	0.2%	0.0%
Extrathoracic airways	7.3%	1.5%	0.4%	0.5%	1.0%	0.0%
Gall bladder wall	0.5%	40.9%	11.6%	12.7%	0.0%	0.0%
Heart wall	2.5%	0.0%	0.0%	0.0%	82.6%	0.0%
Kidneys	1.7%	3.9%	1.0%	1.1%	0.2%	0.0%

Lymph	5.1%	0.0%	0.0%	0.0%	1.3%	0.0%
Muscle	12.9%	0.4%	0.1%	0.1%	0.4%	0.0%
Oral mucosa	3.0%	0.7%	0.2%	0.2%	0.4%	0.0%
Pancreas	1.8%	14.6%	4.2%	4.0%	0.4%	0.0%
Prostate	3.0%	1.3%	0.4%	0.4%	1.1%	0.1%
Small intestine wall	3.5%	0.0%	0.0%	0.0%	0.5%	0.0%
Spleen	1.3%	0.1%	0.0%	0.0%	0.8%	0.0%
Thymus	0.9%	0.2%	0.1%	0.1%	33.7%	0.3%

RBC - red blood cells; WM fast - white matter fast; WM slow - white matter slow; GM fast – grey matter fast; GM slow - grey matter slow; Fast OT – fast other tissue; Slow OT – slow other tissue

Supplemental Data 24

TABLE 24
Total-effect index for biokinetic parameters
for ^{18}F-FDG according to the ICRP approach

Target	Brain Fs	Brain Ti1	Ht wall Fs	Ht wall Ti1	Lungs Fs	Lungs Ti1	Liver Fs
Brain	48.8%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Breast	0.0%	0.0%	2.8%	0.0%	0.8%	0.0%	0.6%
Colon	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.8%
Endosteum	3.1%	0.0%	0.1%	0.0%	0.2%	0.0%	0.2%
Liver	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%	52.3%
Lungs	0.0%	0.0%	1.4%	0.0%	37.7%	0.0%	0.3%
Oesophagus	0.1%	0.0%	31.5%	0.0%	3.4%	0.0%	2.1%
Red marrow	1.2%	0.0%	1.0%	0.0%	0.5%	0.0%	0.6%
Salivary glands	8.7%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Skin	0.4%	0.0%	0.1%	0.0%	0.1%	0.0%	0.2%
Stomach wall	0.0%	0.0%	8.2%	0.0%	0.8%	0.0%	8.5%
Testes	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Thyroid	0.4%	0.0%	1.0%	0.0%	0.9%	0.0%	0.1%
Urinary bladder wall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Adrenals	0.0%	0.0%	1.5%	0.0%	0.5%	0.0%	23.2%
Extrathoracic airways	24.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Gall bladder wall	0.0%	0.0%	0.5%	0.0%	0.1%	0.0%	41.4%
Heart wall	0.0%	0.0%	55.0%	0.0%	0.0%	0.0%	0.0%
Kidneys	0.0%	0.0%	0.3%	0.0%	0.1%	0.0%	5.0%
Lymph	0.1%	0.0%	2.3%	0.0%	0.4%	0.0%	0.8%
Muscle	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.1%
Oral mucosa	7.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Pancreas	0.0%	0.0%	0.7%	0.0%	0.2%	0.0%	10.9%
Prostate	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Small intestine wall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.5%
Spleen	0.0%	0.0%	4.9%	0.0%	2.0%	0.0%	1.0%
Thymus	0.0%	0.0%	10.8%	0.0%	2.4%	0.0%	0.2%

Target	Liver Ti1	Others Ti1	Others ai1	Others Ti2	Others ai2	Others Ti3	UB cont Ti1
Brain	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Breast	0.0%	0.0%	0.0%	0.5%	2.0%	0.0%	0.0%
Colon	0.0%	0.0%	0.0%	0.6%	2.2%	0.0%	0.1%
Endosteum	0.0%	0.0%	0.0%	0.9%	3.3%	0.0%	0.0%
Liver	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Lungs	0.0%	0.0%	0.0%	0.0%	0.1%	0.0%	0.0%
Oesophagus	0.0%	0.0%	0.0%	0.8%	2.9%	0.0%	0.0%

Red marrow	0.0%	0.0%	0.0%	1.1%	4.1%	0.0%	0.1%
Salivary glands	0.0%	0.0%	0.0%	0.7%	2.6%	0.0%	0.0%
Skin	0.0%	0.0%	0.0%	1.1%	3.9%	0.0%	0.0%
Stomach wall	0.0%	0.0%	0.0%	1.1%	4.2%	0.0%	0.0%
Testes	0.0%	0.0%	0.0%	0.4%	1.5%	0.0%	0.0%
Thyroid	0.0%	0.0%	0.0%	0.9%	3.3%	0.0%	0.0%
Urinary bladder wall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%
Adrenals	0.0%	0.0%	0.0%	1.3%	4.6%	0.0%	0.0%
Extrathoracic airways	0.0%	0.0%	0.0%	0.7%	2.3%	0.0%	0.0%
Gall bladder wall	0.0%	0.0%	0.0%	0.4%	1.4%	0.0%	0.0%
Heart wall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Kidneys	0.0%	0.0%	0.0%	1.1%	4.1%	0.0%	0.0%
Lymph	0.0%	0.0%	0.0%	0.8%	3.0%	0.0%	0.1%
Muscle	0.0%	0.0%	0.0%	0.8%	3.1%	0.0%	0.0%
Oral mucosa	0.0%	0.0%	0.0%	0.4%	1.4%	0.0%	0.0%
Pancreas	0.0%	0.0%	0.0%	1.0%	3.6%	0.0%	0.0%
Prostate	0.0%	0.0%	0.0%	0.1%	0.4%	0.0%	0.6%
Small intestine wall	0.0%	0.0%	0.0%	0.7%	2.6%	0.0%	0.1%
Spleen	0.0%	0.0%	0.0%	1.8%	6.6%	0.0%	0.0%
Thymus	0.0%	0.0%	0.0%	0.7%	2.5%	0.0%	0.0%

Ht wall – heart wall; Others – other tissue; UB cont – urinary bladder contents

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TABLE 25
Total-effect index for S values for ^{18}F-FDG according to the ICRP approach

Target	Brain	Ht wall	Lungs	Liver	Others	UB cont
Brain	50.4%	0.0%	0.0%	0.0%	0.0%	0.0%
Breast	0.1%	5.5%	1.6%	1.6%	82.7%	0.0%
Colon	0.0%	0.2%	0.0%	2.6%	54.1%	37.0%
Endosteum	4.0%	0.2%	0.4%	0.4%	80.7%	8.9%
Liver	0.0%	0.0%	0.0%	47.5%	0.3%	0.0%
Lungs	0.0%	1.2%	67.8%	0.1%	1.0%	0.0%
Oesophagus	0.1%	3.2%	2.0%	0.5%	49.9%	0.1%
Red marrow	3.8%	1.2%	0.6%	1.4%	69.3%	10.8%
Salivary glands	15.8%	0.1%	0.1%	0.0%	64.1%	0.0%
Skin	1.0%	0.1%	0.1%	0.4%	82.3%	2.2%
Stomach wall	0.0%	10.9%	0.7%	6.8%	53.2%	0.6%
Testes	0.0%	0.0%	0.0%	0.0%	89.2%	7.6%
Thyroid	0.4%	0.1%	1.1%	0.0%	87.0%	0.0%
Urinary bladder wall	0.0%	0.0%	0.0%	0.0%	0.0%	100.8%
Adrenals	0.0%	0.6%	0.2%	45.3%	17.8%	2.9%
Extrathoracic airways	15.8%	0.1%	0.1%	0.0%	65.2%	0.0%
Gall bladder wall	0.0%	0.2%	0.1%	30.3%	27.9%	1.2%
Heart wall	0.0%	43.8%	0.1%	0.0%	0.0%	0.0%
Kidneys	0.0%	0.0%	0.1%	7.0%	56.9%	16.7%
Lymph	0.1%	0.4%	0.7%	0.6%	66.7%	23.9%
Muscle	0.2%	0.1%	0.0%	0.1%	81.5%	1.7%
Oral mucosa	73.3%	0.1%	0.0%	0.0%	23.4%	0.0%
Pancreas	0.0%	1.1%	0.2%	26.9%	56.8%	1.5%
Prostate	0.0%	0.0%	0.0%	0.0%	25.2%	78.0%
Small intestine wall	0.0%	0.0%	0.0%	0.3%	36.5%	57.4%
Spleen	0.0%	0.8%	1.7%	2.5%	62.3%	2.3%
Thymus	0.3%	13.4%	4.5%	0.4%	67.4%	0.0%

Ht wall – heart wall; Others – other tissue; UB cont – urinary bladder contents

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TABLE 26
Total-effect index for biokinetic parameters
for ^{99m}Tc-MAA

Target	Lungs Ti1	Lungs ai1	Lungs Ti2	Liver Fs	Liver Ti1	Liver Tj1	Kidneys Ti1	UB cont Ti1	Others Ti1
Brain	0.7%	0.0%	0.0%	6.4%	0.0%	0.0%	0.0%	0.0%	1.3%
Breast	1.3%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%
Colon	0.7%	0.0%	0.0%	1.5%	0.0%	0.8%	0.8%	0.3%	0.1%
Endosteum	1.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
Liver	1.0%	0.0%	0.0%	15.2%	0.0%	4.1%	4.1%	0.0%	0.0%
Lungs	2.4%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Oesophagus	1.5%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Red marrow	1.2%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%
Salivary glands	1.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.1%
Skin	1.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%	0.0%	0.0%
Stomach wall	1.7%	0.0%	0.0%	2.0%	0.0%	0.7%	0.7%	0.0%	0.0%
Testes	0.0%	0.0%	0.0%	8.9%	0.0%	0.0%	0.0%	1.7%	1.7%
Thyroid	1.2%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Urinary bladder wall	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	8.6%	0.0%
Adrenals	1.0%	0.0%	0.0%	5.3%	0.0%	1.6%	1.6%	0.0%	0.0%
Extrathoracic airways	1.3%	0.0%	0.0%	0.9%	0.0%	0.0%	0.0%	0.0%	0.2%
Gall bladder wall	0.6%	0.0%	0.0%	22.3%	0.1%	6.4%	6.4%	0.0%	0.0%
Heart wall	1.3%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%
Kidneys	0.8%	0.0%	0.0%	4.4%	0.0%	1.5%	1.5%	0.0%	0.0%
Lymph	7.7%	0.0%	0.0%	1.2%	0.0%	0.7%	0.7%	0.3%	0.0%
Muscle	1.2%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%
Oral mucosa	6.1%	0.0%	0.0%	1.4%	0.0%	0.0%	0.0%	0.0%	0.4%
Pancreas	1.0%	0.0%	0.0%	6.5%	0.0%	2.1%	2.1%	0.0%	0.0%
Prostate	0.0%	0.0%	0.0%	1.3%	0.0%	0.0%	0.0%	36.0%	0.3%
Small intestine wall	0.9%	0.0%	0.0%	1.7%	0.0%	1.5%	1.5%	0.7%	0.2%
Spleen	1.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Thymus	0.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

UB cont – urinary bladder contents

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TABLE 27
Total-effect index for S values
for ^{99m}Tc-MAA

Target	Lungs	Liver	Kidneys	UB cont	Others
Brain	54.7%	0.0%	0.0%	0.0%	32.5%
Breast	97.1%	0.6%	0.0%	0.0%	0.1%
Colon	80.9%	14.0%	0.0%	1.7%	1.6%
Endosteum	95.1%	1.0%	0.0%	0.0%	2.7%
Liver	75.4%	4.5%	0.0%	0.0%	0.1%
Lungs	94.7%	0.0%	0.0%	0.0%	0.0%
Oesophagus	98.2%	0.1%	0.0%	0.0%	0.0%
Red marrow	90.6%	0.5%	0.0%	0.0%	0.1%
Salivary glands	90.9%	0.0%	0.0%	0.0%	4.0%
Skin	91.3%	0.7%	0.0%	0.1%	0.3%
Stomach wall	93.8%	1.9%	0.0%	0.0%	0.5%
Testes	0.0%	0.0%	0.0%	2.8%	86.0%
Thyroid	99.4%	0.0%	0.0%	0.0%	0.1%
Urinary bladder wall	0.0%	0.0%	0.0%	93.3%	0.3%
Adrenals	82.8%	11.8%	0.0%	0.0%	0.6%
Extrathoracic airways	97.0%	0.1%	0.0%	0.0%	5.7%
Gall bladder wall	49.0%	15.9%	0.0%	0.0%	0.4%
Heart wall	98.2%	0.0%	0.0%	0.0%	0.0%
Kidneys	80.6%	10.2%	0.1%	0.2%	2.6%
Lymph	87.4%	0.1%	0.0%	0.8%	0.2%
Muscle	97.4%	0.2%	0.0%	0.1%	1.6%
Oral mucosa	95.9%	0.4%	0.0%	0.0%	5.9%
Pancreas	69.7%	20.6%	0.0%	0.0%	1.7%
Prostate	0.1%	0.1%	0.0%	62.9%	2.7%
Small intestine wall	69.7%	3.3%	0.0%	8.0%	9.8%
Spleen	99.6%	0.2%	0.0%	0.0%	0.1%
Thymus	98.2%	0.0%	0.0%	0.0%	0.0%

UB cont – urinary bladder contents; Others – other tissue