Waza-ari

-A web-based CT dose calculator-

WAZA-ARI v2
USER MANUAL

Ver. 20220601

National Institutes for Quantum Science and Technology

National Institute of Radiological Sciences

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Contents

1.Preface

1.1. **Preface**

This manual is a user manual of WAZA-ARI v2, the web system for evaluating exposure dose from CT. The instruction, calculation algorithm and parameters for WAZA-ARI v2 are summarized in this manual. And it was edited by the following members who developed WAZA-ARI v2.

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1.2. **Background of the development of WAZA-ARIv2**

Recently, CT scan has been widely used in medical institutions while exposure dose from CT scan is much higher than that from radiography. Therefore, the International Atomic Energy Agency IAEA has called for more attention to exposure dose by radiography in early childhood and repeated radiography for the same patients. Japanese medical-related societies have also begun to manage exposure doses caused by medical behavior during the patient's life in order to prevent excessive exposure. Japan had a relatively large number of CT scanners per million population. According to the survey in 2005, more than 20.7 million scans per year was recorded. Nevertheless, the system for managing total medical exposure of patients has not been constructed in Japan.

To solve the above-mentioned problems, Japan's National Institutes for Quantum and Radiological Science and Technology (QST), Japan Atomic Energy Development Agency (JAEA), and the Oita University of Nursing and Health Sciences (Oita Pref. Nursing) renewed the WAZA-ARI system which was developed in 2012. The renewal system WAZA-ARI v2 can evaluate patient dose from CT scans and officially started to serve in January 2015 under the management of QST. [1][2]

1.3. **Features of WAZA-ARIv2**

WAZA-ARI is the second highest score a fighter can achieve in a Japanese martial arts ippon or waza-ari contest such as judo. The CT dose evaluation system WAZA-ARIv2 shares the same features with WAZA-ARI, which has served from Dec. 2012.

【Web-based system】

WAZA-ARIv2 was developed to be a web-based system so that installation and maintenance will never be a burden to users. After accessing the web site, users can calculate dose from CT by entering information such as the model of CT scanner, the scanning range, the age, body shape, and gender of the patient. The result will display immediately after the scanning conditions are set.

WAZA-ARIv2 has the following new functions

【Dose calculation for patients of various body shapes and ages】

The previous version of WAZA-ARI only calculates organ doses for the average Japanese adults. On the other hand, WAZA-ARIv2 calculates not only standard body shape but also fat and thin people so that most Japanese can be covered. Besides, dose calculation is supported for underage patients with the age of 0, 1, 5, 10, or 15. Dose calculation was mainly performed by simulation code developed by JAEA, and the phantoms used for calculation include the newly developed Japanese adult phantoms and the child phantoms developed by the University of Florida and the National Cancer Institute of the US.

【Construction of registered dose data statistically for CT scanning condition optimization】

After registration, users can calculate organ dose by entering required information and register the data on the QST server. WAZA-ARIv2 server, on the other hand, can collect dose data of each institution and estimate the distribution of dose from CT in Japan. Users can compare the dose level between their own institutions and the dose level of the registered data in WAZA-ARIv2 and use it to optimize CT scanning conditions to prevent overexposure of patients.

Calculation results are modified to display on the right side of the window for setting the scanning conditions in WAZA-ARIv2. In addition, the layout has been changed so that users can see the scanning conditions and the calculation results at the same time. Functions of registering calculation results and frequently used scanning conditions are also added for convenience.

2.Registration

ID registration is required to use WAZA-ARIv2 for dose calculation, dose registration, and dose distribution confirmation. The registration contents include name, email address, occupation, number of beds, number of annual CT tests, name of medical institution, etc.

2.1. **User registration page**

Press the "ID registration" button on the login page of WAZA-ARIv2 to go to ID registration page. After entering the required information, press the "Confirm" button for confirmation.

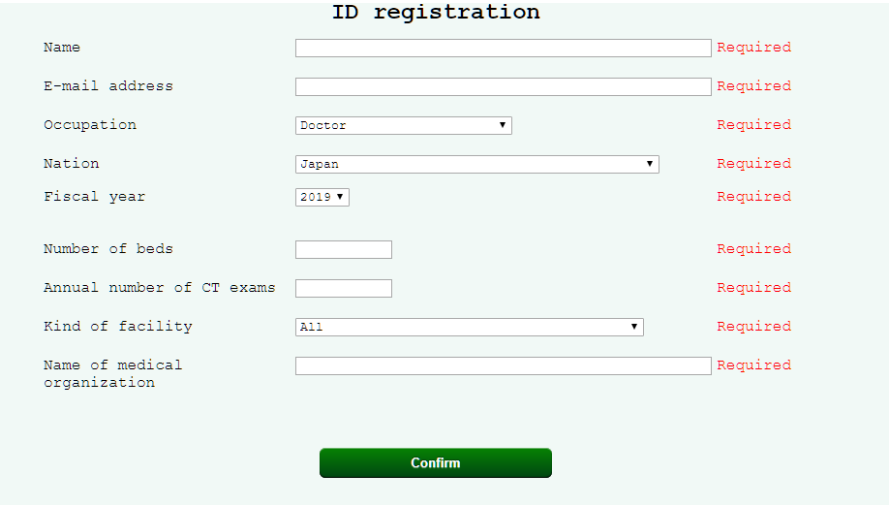


Fig. 2-1. Page for user ID registration

2.2. **Confirmation of registered content for user ID**

Please check if the registered information is correct and read the terms of use for this site. Tick the checkbox and press "Register" button if you agree with the terms of us. Press "Revise" button to return to the input page and revise it if there is any mistake.

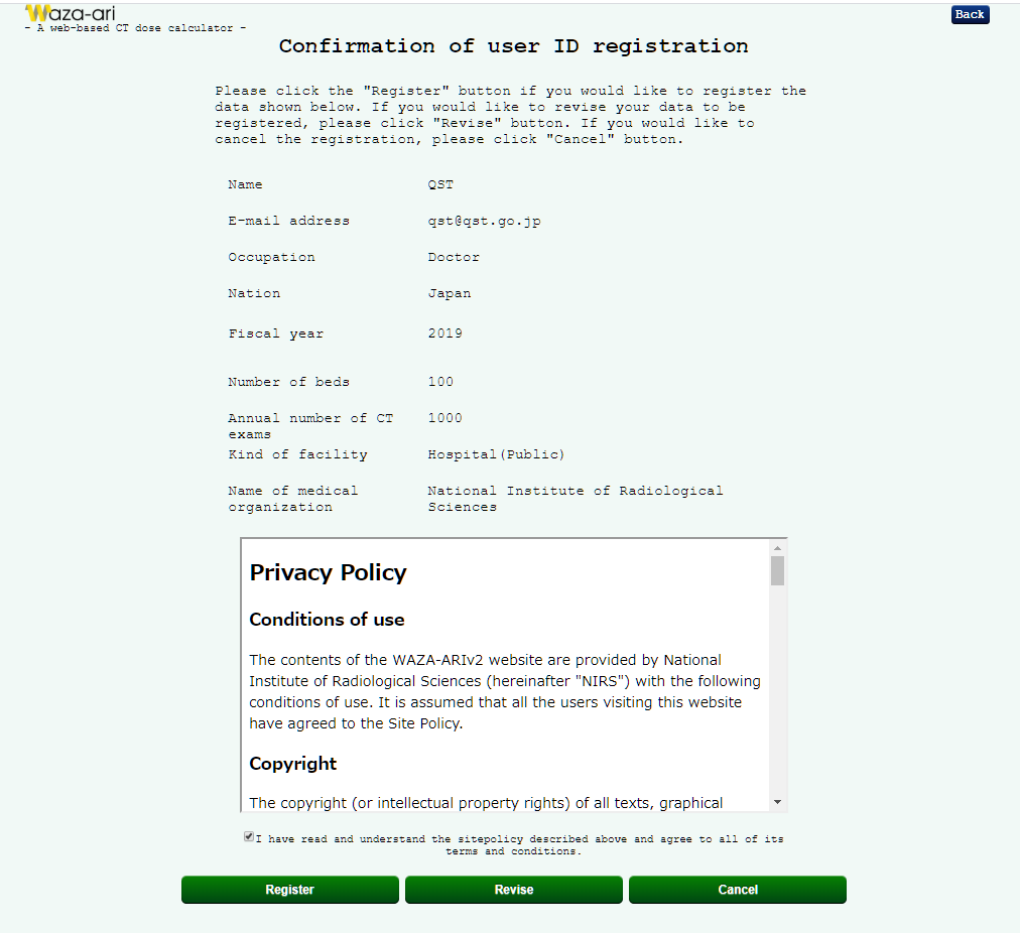
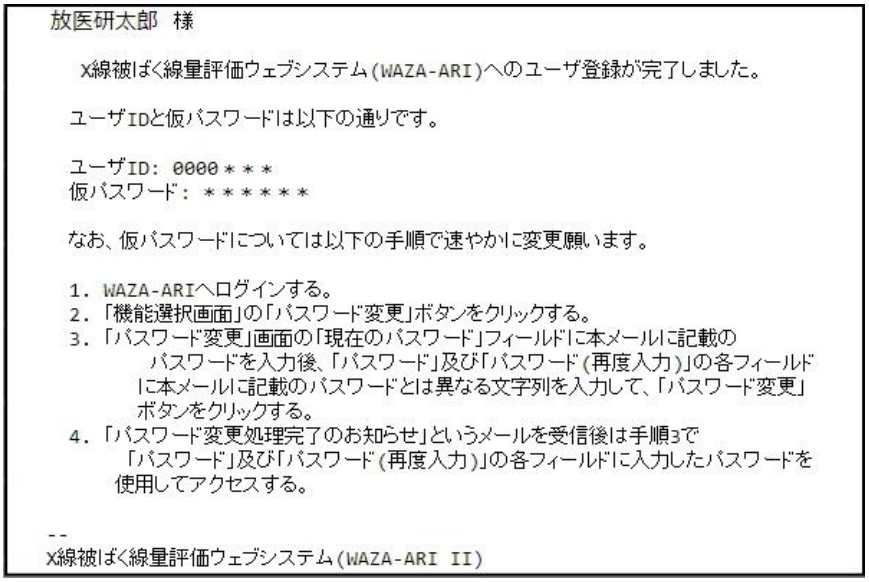


Fig. 2-2. Confirmation page for the registered content of user ID

2.3. **Confirmation of the user ID registration**

You will receive a registration completion email as shown below (Japanese only). The "User ID" and "Temporary Password" are included in this e-mail. Password can be changed after WAZA-ARI v2 login



放医研太郎 様

X線被ばく線量評価ウェブシステム(WAZA-ARI)へのユーザ登録が完了しました。

ユーザIDと仮パスワードは以下の通りです。

ユーザID: 0000＊＊＊
仮パスワード: ＊＊＊＊＊＊

なお、仮パスワードについては以下の手順で速やかに変更願います。

1. WAZA-ARIへログインする。
2. 「機能選択画面」の「パスワード変更」ボタンをクリックする。
3. 「パスワード変更」画面の「現在のパスワード」フィールドに本メールに記載の
   パスワードを入力後、「パスワード」及び「パスワード(再度入力)」の各フィールド
   に本メールに記載のパスワードとは異なる文字列を入力して、「パスワード変更」
   ボタンをクリックする。
4. 「パスワード変更処理完了のお知らせ」というメールを受信後は手順3で
   「パスワード」及び「パスワード(再度入力)」の各フィールドに入力したパスワードを
   使用してアクセスする。

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X線被ばく線量評価ウェブシステム(WAZA-ARI II)

Fig. 2-3. Sample of the registration completion email

3.Dose calculation

3.1. **Setting of the condition for dose calculation**

After login, press "Calculation of the X-ray CT exposures" button on the Main menu page (Fig. 3.1) to go to dose calculation page(Fig. 3.2).

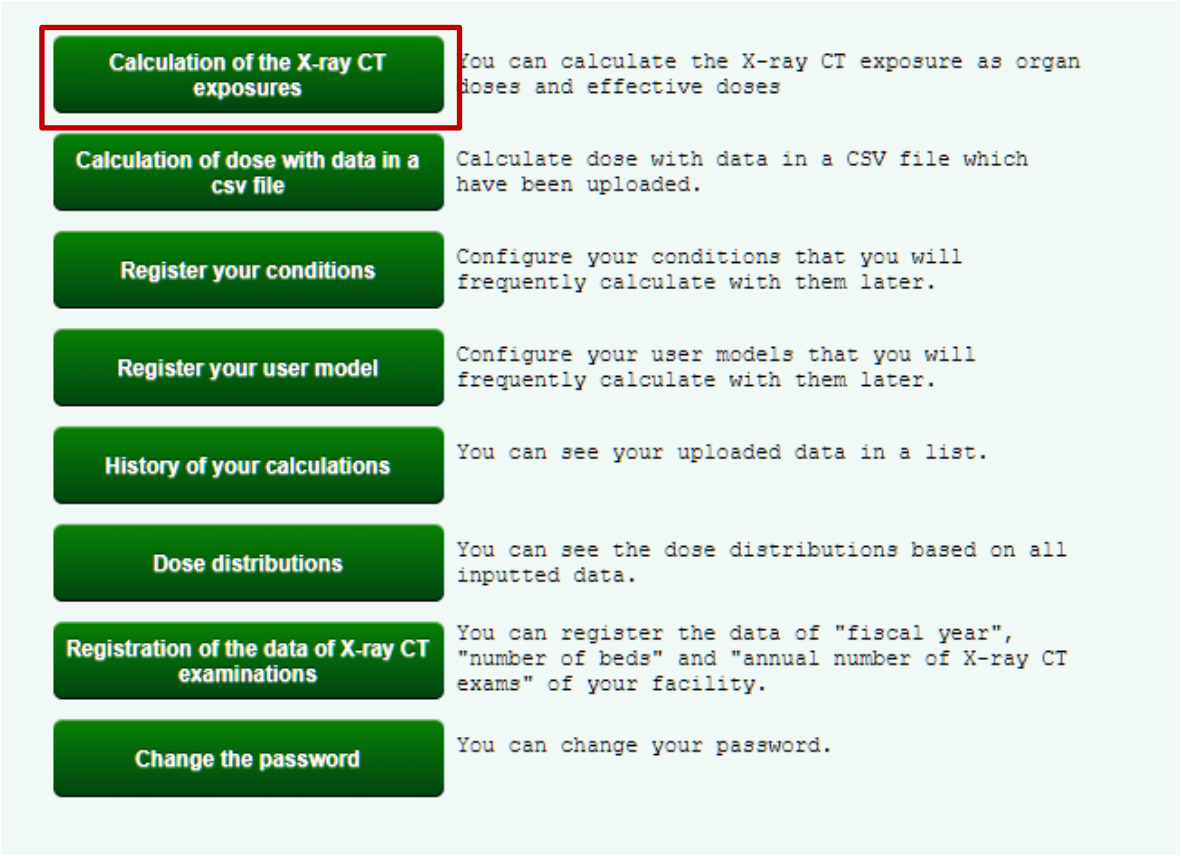


Fig. 3-1. Main menu（dose calculation）

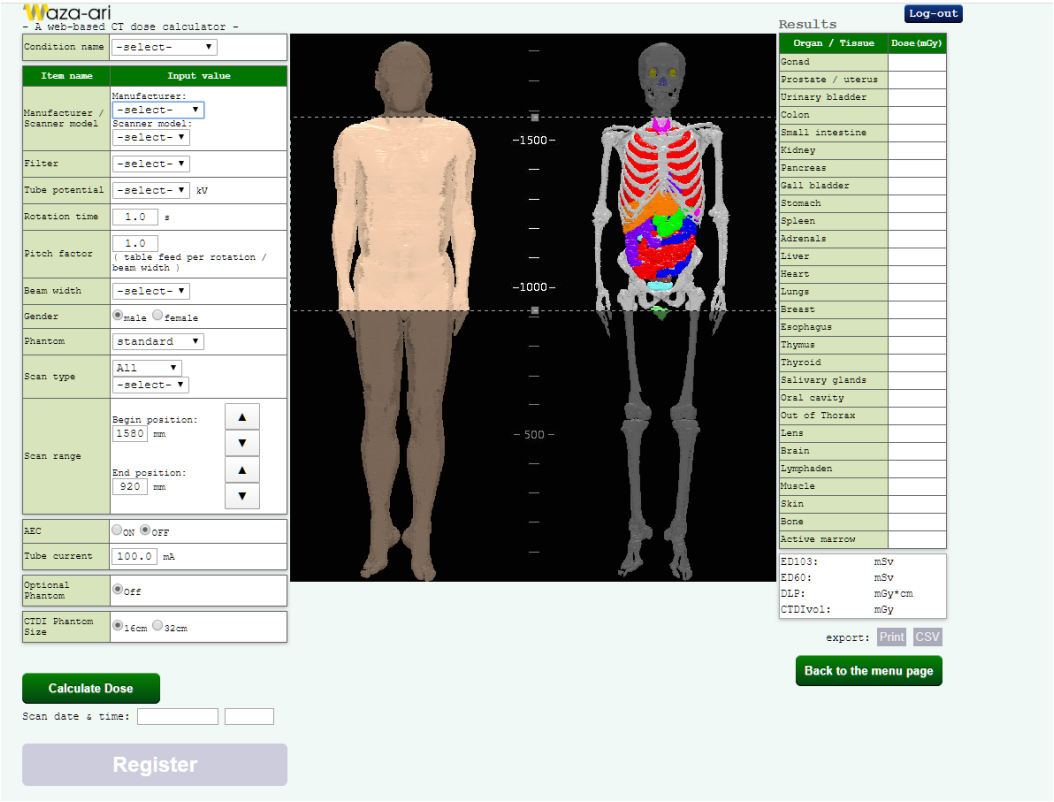


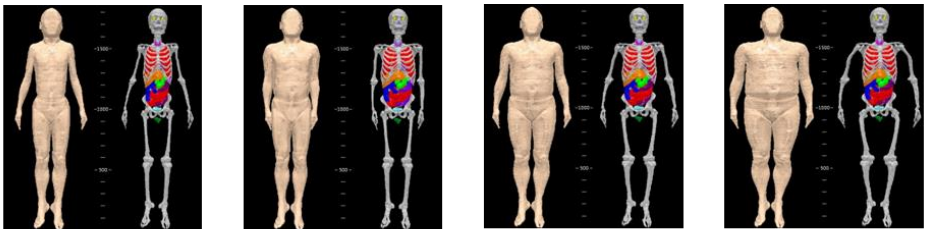
Fig. 3-2. Page for calculation of the X-ray CT exposures

Scanning conditions for dose calculation are set in the left column on dose calculation page. Detail of the scanning condition items are shown in Table 3-1 and detail of the available phantoms are shown in Table 3-2 and Fig. 3-3. Height, weight and BMI for each phantom are shown in Table 3-2.

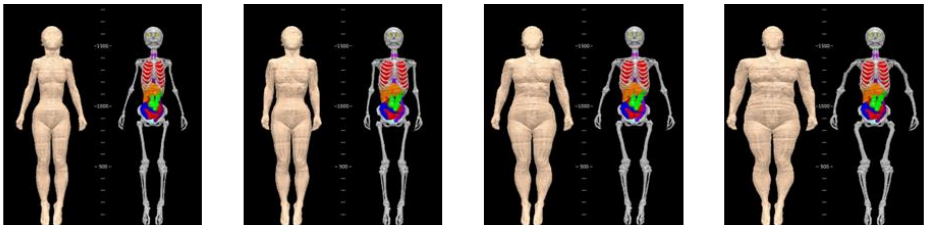
Two new functions of (1) BMI-based organ dose calculation and (2) SSDE calculation are added in Feb 2021. If you select Adult optional phantom in the phantom item, body shape correction function (optional phantom) will be turned on and columns of height and weight display (Fig. 3-4). Using BMI estimated by the entered height and weight, it has potential to calculate the organ dose closer to the body shape of the subject. Phantom displayed on the calculation screen does not change with the entered height and weight. In WAZA-ARIv2, SSDE is calculated using $CTDI_{vol}$ and the conversion factors proposed in AAPM TG 204, and the conversion factor is a function of effective diameter (AP: anterior-posterior dimension, LAT: lateral dimension). Fig. 3-5 shows the calculation screen when SSDE is turned on.

Table 3-1. Scanning condition item for dose calculation

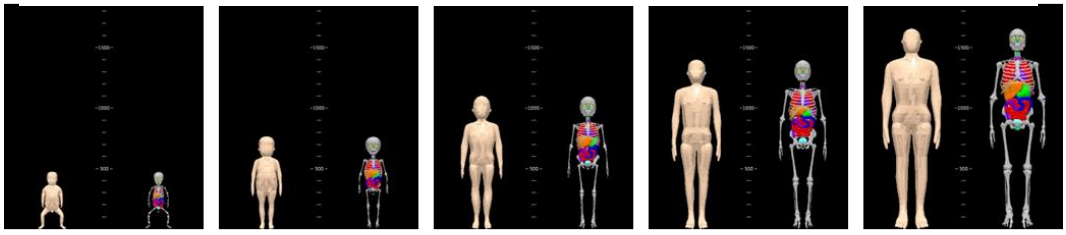
Item	Description
Manufacturer	Vender of CT machine
Scanner model	Name of the CT scanner model
Filter	Name of the Bow-tie filter that depends on the of FOV
Tube potential	Tube Voltage [kV]
Rotation time	Time required for one rotation of the tube [s]
Pitch factor	Pitch for helical scan mode. (Movement of the table for one rotation of tube) / (beam width)
Beam width	Collimation range in the direction of body axis
Gender	Gender
Phantom	Select a phantom according to the body type and age. Adult: Standard, Fat(+2SD), Fat(+5SD) and Thin(-2SD) Child: age:0～15 Adult optional phantom
Scan type	Scan type (region of body)
Scan range	Enter the scanning range. The scanning range can also be set by dragging the ☐ part on the center phantom image
AEC (Option)	"On" to enable dose calculation for the case of AEC (Auto Exposure Control) is applied. Setting the tube current for the specific slice is necessary.
Tube Current	Tube Current
Optional Phantom	The function of body shape correction is planned to be implemented in the future.
SSDE(Option)	"On" to enable calculation of SSDE (Size Specific Dose Estimates). P.S. Since SSDE is estimated using effective diameter, information of anterior-posterior dimension and lateral dimension are necessary.
CTDI phantom size	CTDI phantom size for calculating $CTDI_{vol}$ and DLP



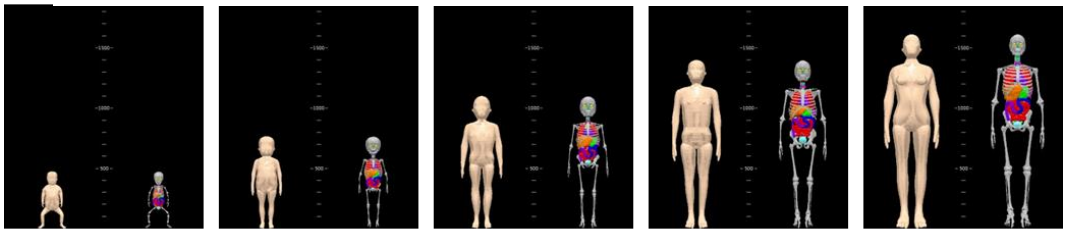
Adult Male (from left to right): thin (-2σ), standard, fat (+2σ), obese (+5σ)



Adult Female (from left to right): thin (-2σ), standard, fat (+2σ), obese (+5σ)



Boy (from left to right): 0-yr-old, 1-yr-old, 5-yr-old, 10-yr-old, 15-yr-old



Girl (from left to right): 0-yr-old, 1-yr-old, 5-yr-old, 10-yr-old, 15-yr-old

Fig. 3-3. Available phantom types

Optional Phantom	ON
Height	cm
Weight	kg

Fig. 3-4. Columns of Height and Weight display when Adult optional phantom is chosen.

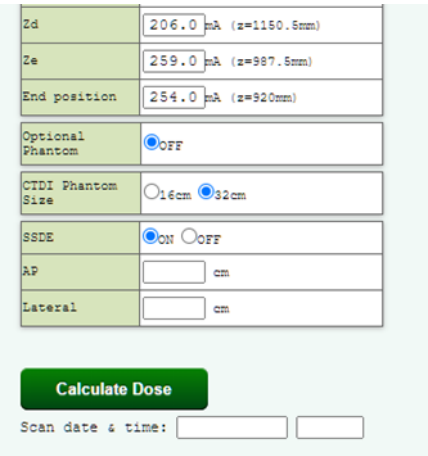


Fig. 3-5. Columns of AP and Lateral display when SSDE is set "on".

Table 3-2. Height, weight and BMI for each phantom used in WAZA-ARI[3][4]

	Male			Female		
	height[cm]	weight[kg]	BMI*	height[cm]	weight[kg]	BMI*
Standard	171	65.1	22.3	155	52	21.6
+2σ : Fat(+2SD)	171	82.2	28.1	155	66.9	27.8
+5σ : Fat(+5SD)	171	118.1	40.4	155	89.5	37.3
-2σ : Thin(-2SD)	171	54.1	18.5	155	43	17.9
age:0	47.5	3.5	15.5	47.5	3.5	15.5
age:1	76.4	10.2	17.5	76.4	10.3	17.6
age:5	110.2	19.7	16.2	110.2	19.7	16.2
age:10	139.8	34.3	17.6	139.8	34.3	17.6
age:15	165.7	59.9	21.8	161.1	56.6	21.8

* $\mathrm{BMI} = (\mathrm{Weight[kg]})/\mathrm{Height[m]})^2$

3.2. **Confirmation of dose calculation results**

After setting the appropriate conditions, press "Calculation dose" button to start dose calculation, and the dose calculation result will display. In addition to absorbed dose [mGy] to each organ, the effective dose (ED103, ED60) [mSv], DLP and CTDIvol are also displayed.

Absorbed dose · Equivalent dose · Effective dose

Equivalent dose H_T [mSv] of each organ is obtained by using the radiation weighting factor w_R and the absorbed dose D_{TR} [mGy] as follows.

$$H_T = w_R \times D_{TR}$$

Since w_R for X-ray is 1, D_{TR} [mGy] of each organ is equal to H_T [mSv]. Effective dose E is then calculated by summing the product of the tissue weighting factor w_T of each organ and [mSv] H_T for all organs.

$$E = \sum_T w_T H_T$$

Since the definition of w_T for each organ is different between ICRP103[5] and ICRP60[6], ED103 and ED60 are both displayed in the calculation result of WAZA-ARI.

It is worth to mention that WAZAARIv2 calculates *E* using Japanese phantom which is different from the phantom defined by ICRP. Therefore, strictly speaking, it is not proper to compare *E* calculated by WAZA-ARIv2 with that by other calculation software.

3.3. **Registration of calculation results**

You can browse statistical information of the registered data and compare with data registered in WAZA-ARIv2 with the statistical information of the radiation dose of your facility by registering the calculation results on the QST server. Press "Register" button to confirm your data for registration (Fig. 3-6).

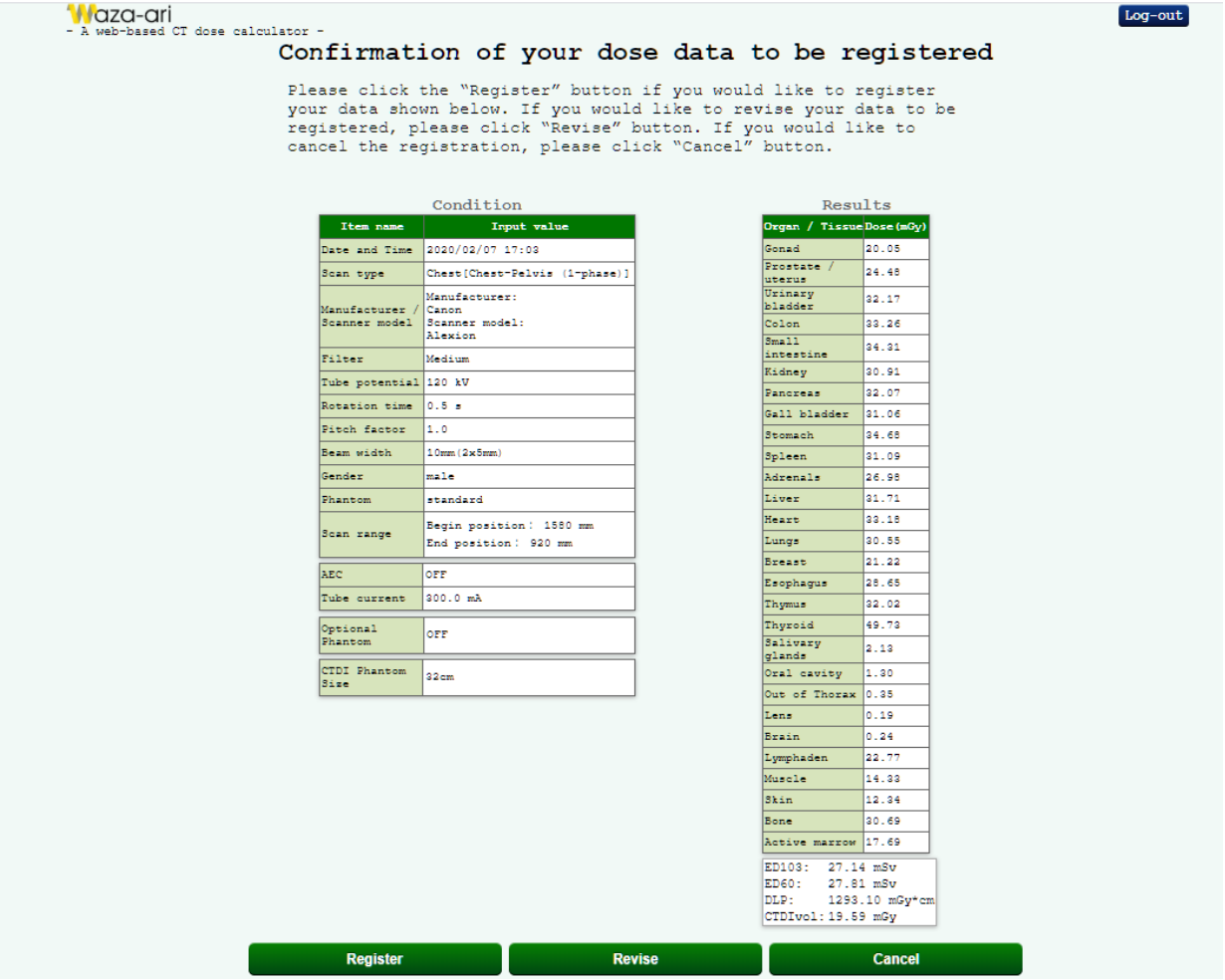


Fig. 3-6. Page for confirming the registered dose information

4. Dose calculation・registration using csv file

WAZA-ARIv2 can calculate and register multiple cases with different scanning condition by using a list file of csv format.　Selecting "Calculation of dose with data in a csv file" on the Main menu (Fig. 4-1), the page for dose calculation and registration from csv file can will be shown as Fig. 4-2.

4.1. **Dose calculation・registration using csv file**

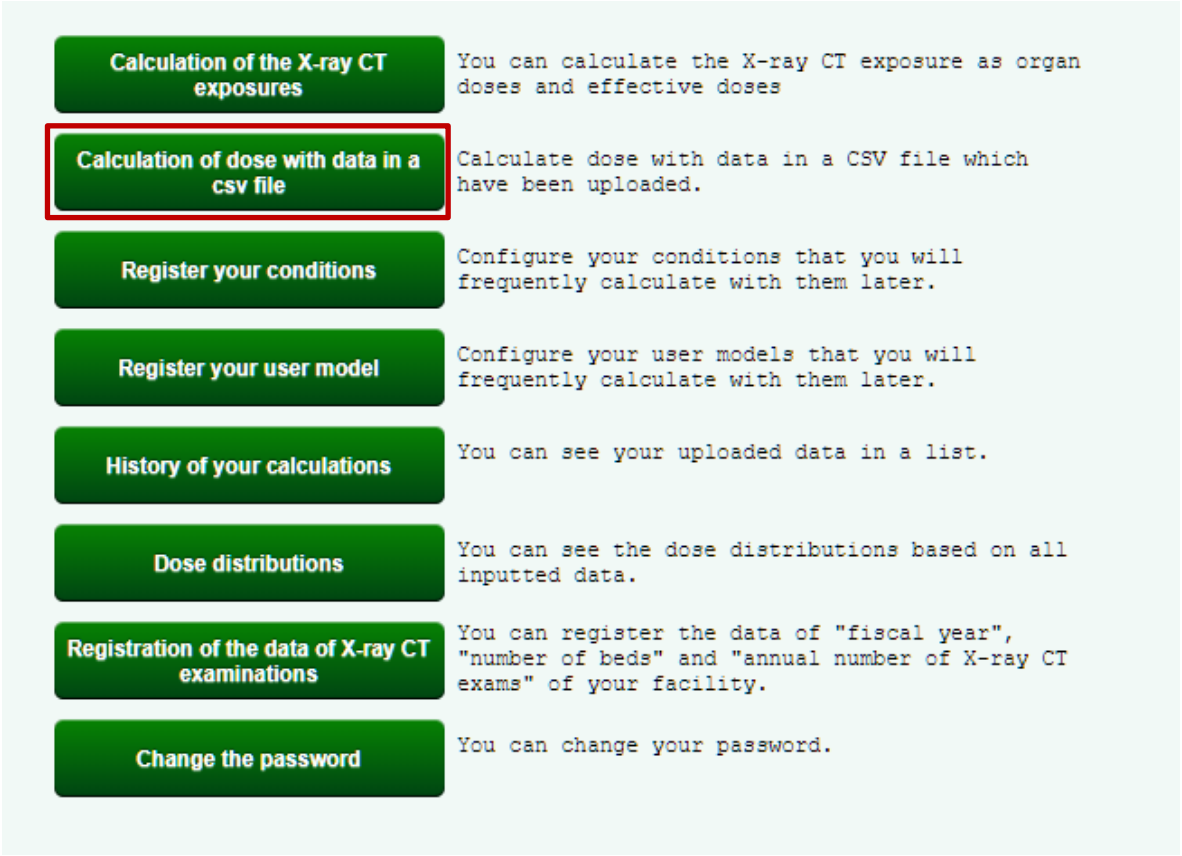


Fig. 4-1. Main menu（Calculation of dose with data in a csv file）

Fig. 4-2. Page for calculation of dose with data in a csv file

Press ファイルを選択 to select the csv file and then press "Confirm data" button to check the content of upload data as it shown in Fig. 4-3. If any improper condition is included in the csv file, a warning message as shown in Fig. 4-4 will display and the upload process will stop.

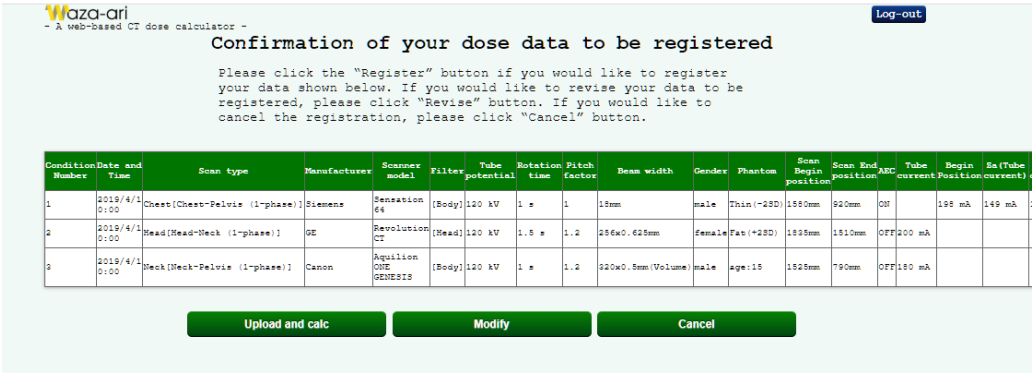


Fig. 4-3. Confirmation of the registered dose information

Fig. 4-4. Screenshot for confirmation of improperly registered scanning condition

4.2. **List file of scanning condition**

You can download a sample list file (csv file and Excel file) on the lower part of the Description section on the homepage for reference and create a scanning condition list file by yourself. The scanning condition list file is a csv format file which is separated by commas in the following order. It is recommended to create a csv file using the example of the Excel file.

（Order of the scanning condition items）	Description
<<Date and Time>>,	: scan time（Ex：2015/7/6 14:03）
<<CT scan type>>,	: scan type
<<Manufacturer>>,	: Manufacturer of CT scanner
<<Scanner model>>,	: Name of the CTs scanner
<<Filter>>,	: Filter corresponding to the size of FOV
<<Tube potential>>,	: Tube Voltage[kV]
<<Rotation time>>,	: Tube rotation time[s]
<<Pitch factor>>,	: Pitch factor
<<Beam width>>,	: Beam width
<<Gender>>,	: Gender（male or female）
<<Phantom>>,	: Type of phantom
<<Scan range Begin position>>,	: Scan range Begin position [mm]
<< Scan range Begin position >>,	: Scan range Begin position [mm]
<<AEC>>,	: ON or OFF
<<Tube current>>,	: Input when AEC OFF
<<Begin position>>,	: Input when AEC ON
<<Za>>,<<Zb>>,<<Zc'>>,	: Input when AEC ON（Not necessary for Zc’）
<<Zc>>,<<Zd>>,<<Ze>>,	: Input when AEC ON
<<End position>>,	: Input when AEC ON
<<Optional Phantom>>,	: ON or OFF
<<Height>>,<<Weight>>,	: N/A
<<AP>>,<<Lateral>>	: N/A
<<CTDI Phantom Size>>	: Phantom Size used for calculating dose index（16 or 32）
<<SSDE>>,	: ON or OFF

5. The setting of user scanning condition

Five frequently used scanning conditions are allowed to registered for each user in WAZA-ARI.

5.1. **The setting of user scanning condition**

After clicking "Register your conditions" button on the Main menu (Fig. 5-1), page for condition registration as shown in Fig. 5-2 will be displayed.

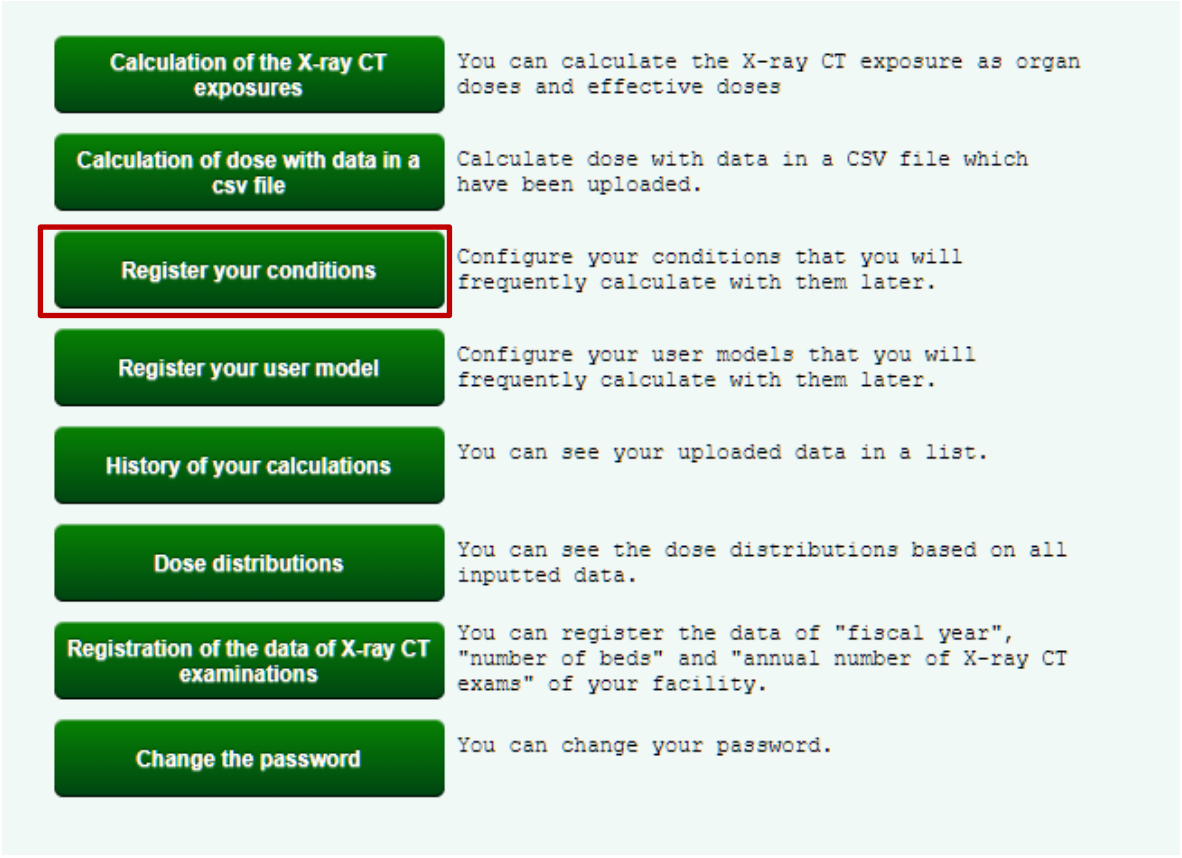


Fig. 5-1. Main menu（Register your conditions）

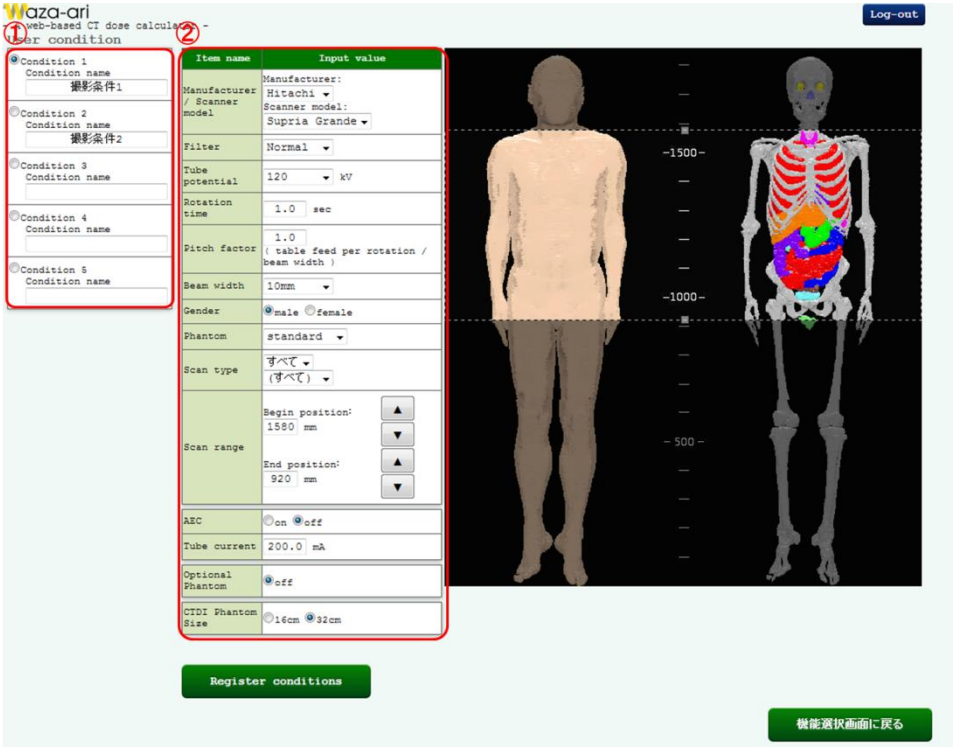


Fig. 5-2. Page for registering user scanning condition

Select the number of the scanning condition from the box ① shown in Fig. 5-2. Name of the scanning condition is required information. Fill the selected scanning condition shown in the box ②. All items are required item. After setting the scanning conditions, press "Register conditions" button and the window for confirmation will be displayed. Press the "Register" button to register if the conditions are correct.

5.2. **Application of user scanning conditions**

Choose the name of the scanning condition from the drop down list of "Condition name" in the upper left of Fig. 3-2 to apply the registered user scanning conditions for dose calculation.

6.Merge of dose calculation and calculation results

You can search, delete, merge, print, and export the dose calculation results in csv format in WAZA-ARIv2.

6.1. **Search, print and delete of dose calculation history**

6.1.1. **Search of dose result from the history of your calculation**

(1) Press "History of your calculation" button on the Main menu to go to the page of history of your calculations.

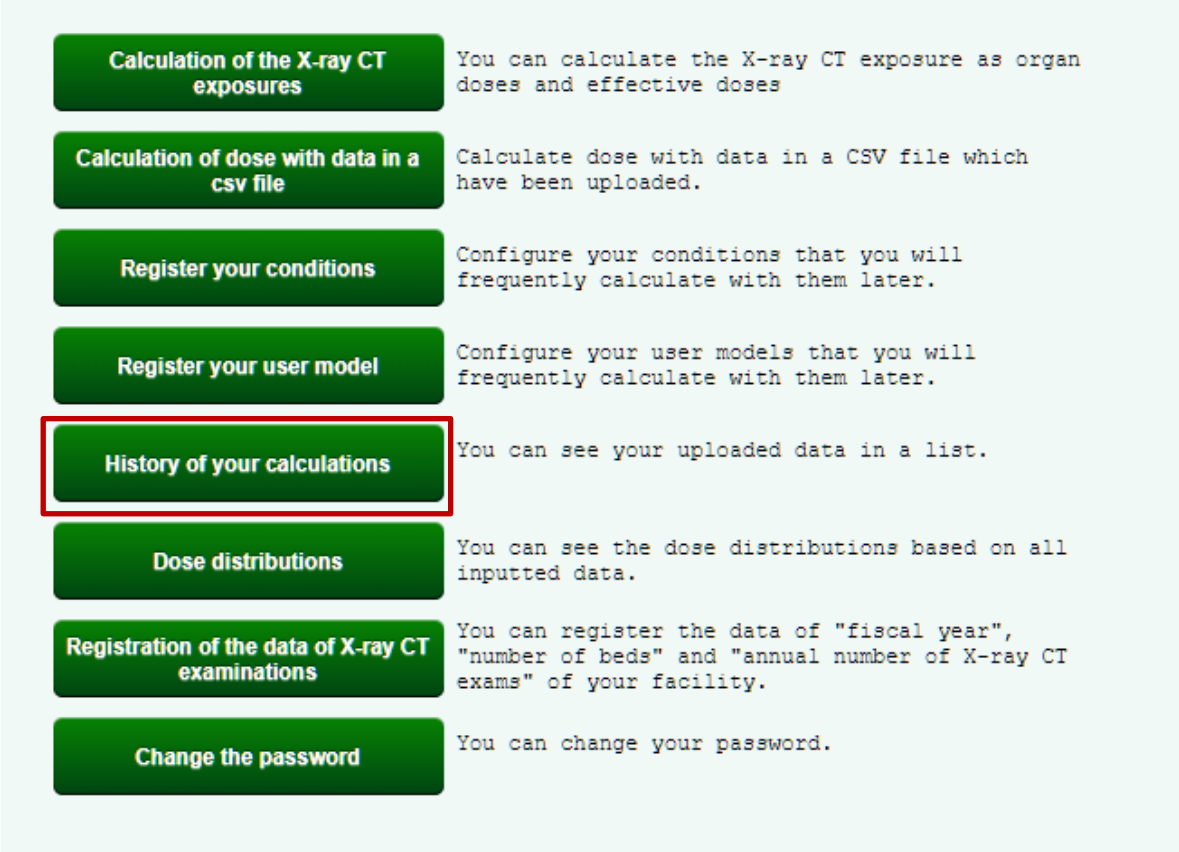
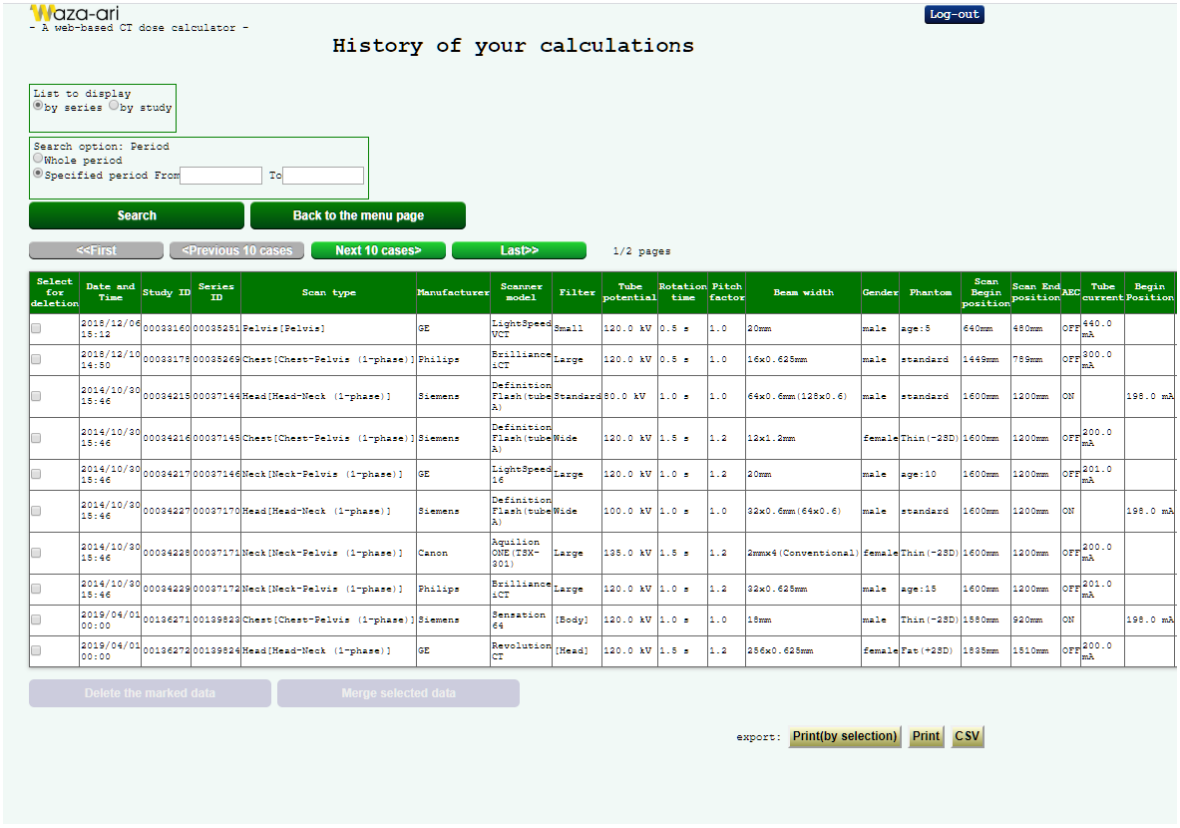


Fig. 6-1. Main menu（History of your calculation）

On the page of history of your calculation, ten cases of calculation results are displayed on each page. It is also possible to display the results for a limited period by specifying the date registered from "Period specified". You can delete, combine, and print only the selected result by ticking the check box on the left of each calculation result.



Select for deletion	Date and Time	Study ID	Series ID	Scan type	Manufacturer	Scanner model	Filter	Tube potential	Rotation time	Pitch factor	Beam width	Gender	Phantom	Scan Begin position	Scan End position	AEC	Tube current	Begin Position
	2018/12/06 15:12	00033160	00035251	Pelvis[Pelvis]	GE	LightSpeed VCT	Small	120.0 kV	0.5 s	1.0	20mm	male	age:5	640mm	480mm	OFF	440.0 mA	
	2018/12/10 14:50	00033178	00035269	Chest[Chest-Pelvis (1-phase)]	Philips	Brilliance iCT	Large	120.0 kV	0.5 s	1.0	16x0.625mm	male	standard	1449mm	789mm	OFF	300.0 mA	
	2014/10/30 15:46	00034215	00037144	Head[Head-Neck (1-phase)]	Siemens	Definition Flash(tube A)	Standard	80.0 kV	1.0 s	1.0	64x0.6mm(128x0.6)	male	standard	1600mm	1200mm	ON		198.0 mA
	2014/10/30 15:46	00034216	00037145	Chest[Chest-Pelvis (1-phase)]	Siemens	Definition Flash(tube A)	Wide	120.0 kV	1.5 s	1.2	12x1.2mm	female	Thin(-25D)	1600mm	1200mm	OFF	200.0 mA	
	2014/10/30 15:46	00034217	00037146	Neck[Neck-Pelvis (1-phase)]	GE	LightSpeed 16	Large	120.0 kV	1.0 s	1.2	20mm	male	age:10	1600mm	1200mm	OFF	201.0 mA	
	2014/10/30 15:46	00034227	00037170	Head[Head-Neck (1-phase)]	Siemens	Definition Flash(tube A)	Wide	100.0 kV	1.0 s	1.0	32x0.6mm(64x0.6)	male	standard	1600mm	1200mm	ON		198.0 mA
	2014/10/30 15:46	00034228	00037171	Neck[Neck-Pelvis (1-phase)]	Canon	Aquilion ONE(TSX-301)	Large	135.0 kV	1.5 s	1.2	2mmx4(Conventional)	female	Thin(-25D)	1600mm	1200mm	OFF	200.0 mA	
	2014/10/30 15:46	00034229	00037172	Neck[Neck-Pelvis (1-phase)]	Philips	Brilliance iCT	Large	120.0 kV	1.0 s	1.2	32x0.625mm	male	age:15	1600mm	1200mm	OFF	201.0 mA	
	2019/04/01 00:00	00136271	00139823	Chest[Chest-Pelvis (1-phase)]	Siemens	Sensation 64	[Body]	120.0 kV	1.0 s	1.0	16mm	male	Thin(-25D)	1880mm	920mm	ON		198.0 mA
	2019/04/01 00:00	00136272	00139824	Head[Head-Neck (1-phase)]	GE	Revolution CT	[Head]	120.0 kV	1.5 s	1.2	256x0.625mm	female	Fat(+25D)	1895mm	1510mm	OFF	300.0 mA	

Fig. 6-2. Page of history of your calculation

6.1.2. **Print**

The registered dose information can be printed for preservation or distribution.

(1) To print only the selected calculation results, check the check box and select "Print (by selection)". Select "Print" to print all the search results displayed.

(2) The “scanning conditions”, “Phantom simulation range”, “Absorbed dose to organ” and “Effective dose” input to WAZA-ARI are printed as shown below.

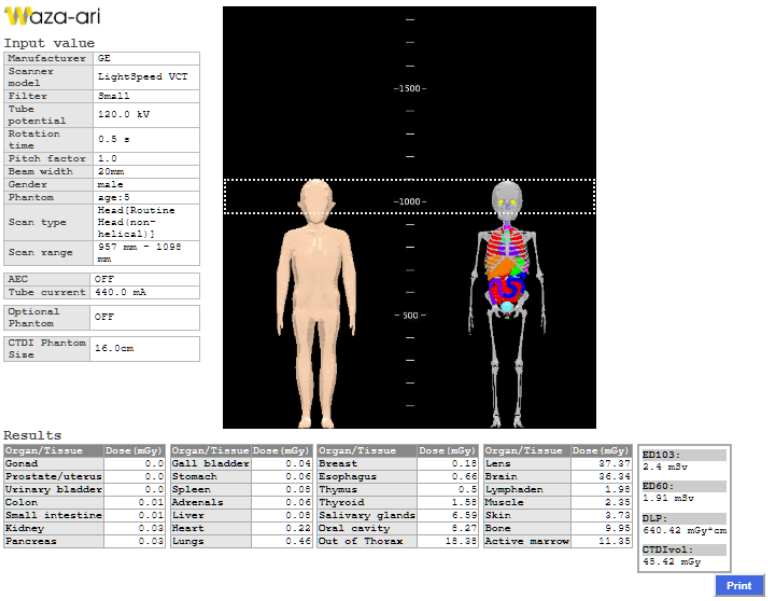


Fig. 6-3. Preview of the print of dose calculation result

(3) After confirming the printed page, click “ 

” for printing.

6.1.3. **Export data in CSV format**

The registered dose information can be used for detailed analysis with spreadsheet software such as excel. CSV

Press on the page of History of your calculation and specify the save destination for saving.

6.1.4. **Delete dose calculation results**

"Delete the marked data" button is not activated in the beginning.

(1) Tick the box "☑" on the left edge of the table and press "Delete the marked data" button to forward to the confirmation page.

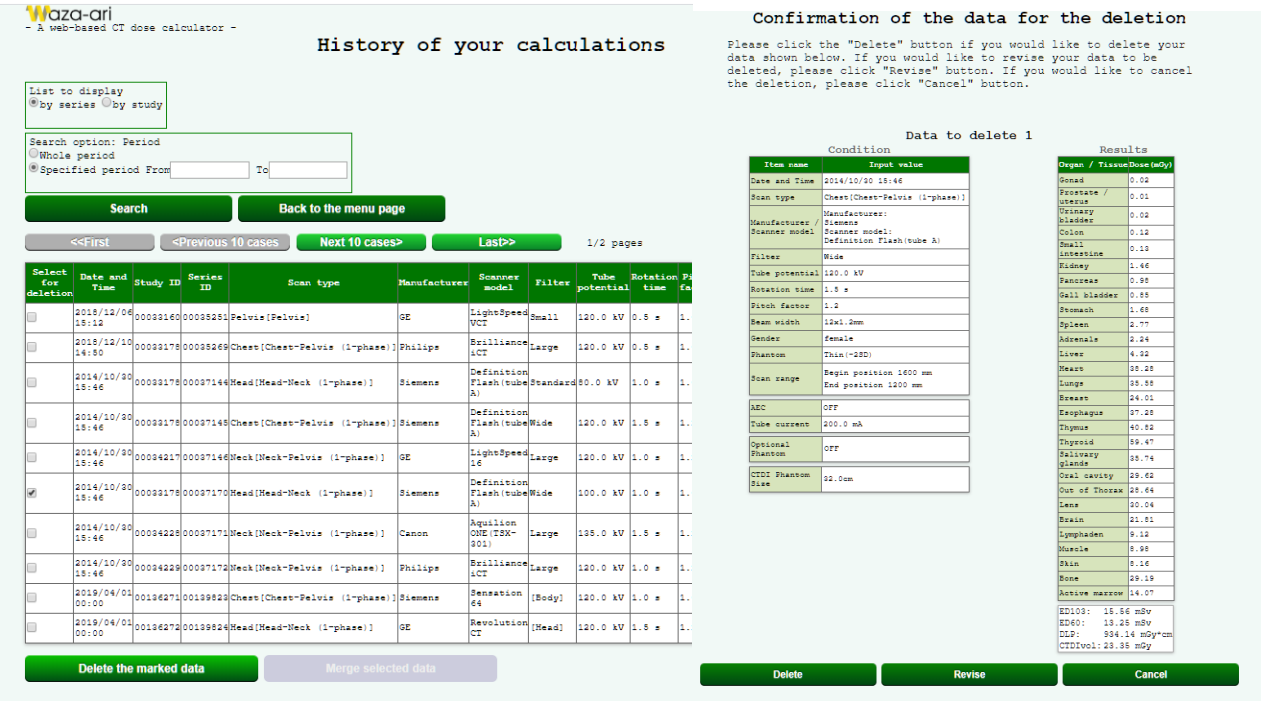


Fig. 6-4. Page of "History of your calculations" and "Confirmation of the data for deletion"

(2) Press "Delete" button to delete the data after confirmation.

(3) Press "Revise" to return to "History of your calculation".

(4) Press "Cancel" button to return to Main menu.

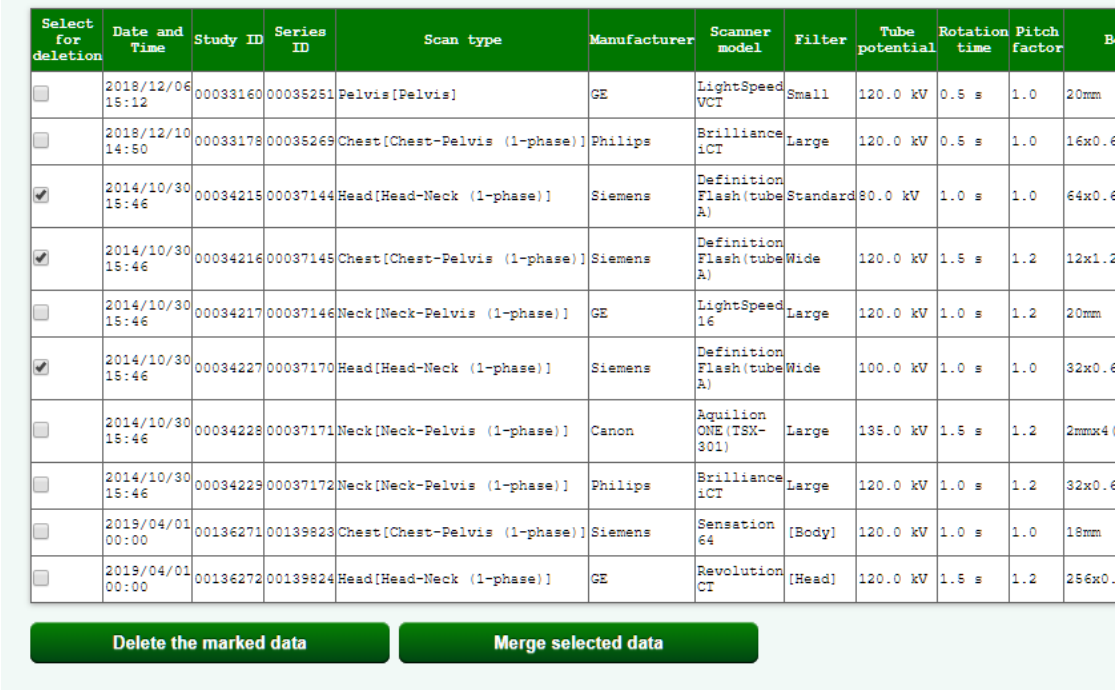
*** Note: Deleted data cannot be recovered.**

6.2. **Merge of the dose calculation result and dose evaluation for the same protocol**

Study ID and Series ID are automatically assigned to the registered dose calculation results. Data for the same patient can be merged to the same Study ID and evaluated in WAZA-ARIv2.

6.2.1. **Merge of the calculation results**

Tick the box of the dose calculation result that you want to merge as shown in Fig. 6-5. The "Merge selected data" button will be active when more than one box was ticked. Press "Merge selected data" button to go to the confirmation page as shown in Fig. 6.6. Press "Merge" button and the Study ID of the selected dose calculation results will be unified as shown in Fig. 6-7.



Select for deletion	Date and Time	Study ID	Series ID	Scan type	Manufacturer	Scanner model	Filter	Tube potential	Rotation time	Pitch factor	B
☐	2018/12/06 15:12	00033160	00035251	Pelvis[Pelvis]	GE	LightSpeed VCT	Small	120.0 kV	0.5 s	1.0	20mm
☐	2018/12/10 14:50	00033178	00035269	Chest[Chest-Pelvis (1-phase)]	Philips	Brilliance iCT	Large	120.0 kV	0.5 s	1.0	16x0.6
☑	2014/10/30 15:46	00034215	00037144	Head[Head-Neck (1-phase)]	Siemens	Definition Flash(tube A)	Standard	80.0 kV	1.0 s	1.0	64x0.6
☑	2014/10/30 15:46	00034216	00037145	Chest[Chest-Pelvis (1-phase)]	Siemens	Definition Flash(tube A)	Wide	120.0 kV	1.5 s	1.2	12x1.2
☐	2014/10/30 15:46	00034217	00037146	Neck[Neck-Pelvis (1-phase)]	GE	LightSpeed 16	Large	120.0 kV	1.0 s	1.2	20mm
☑	2014/10/30 15:46	00034227	00037170	Head[Head-Neck (1-phase)]	Siemens	Definition Flash(tube A)	Wide	100.0 kV	1.0 s	1.0	32x0.6
☐	2014/10/30 15:46	00034228	00037171	Neck[Neck-Pelvis (1-phase)]	Canon	Aquilion ONE(TSX-301)	Large	135.0 kV	1.5 s	1.2	2mmx4(
☐	2014/10/30 15:46	00034229	00037172	Neck[Neck-Pelvis (1-phase)]	Philips	Brilliance iCT	Large	120.0 kV	1.0 s	1.2	32x0.6
☐	2019/04/01 00:00	00136271	00139823	Chest[Chest-Pelvis (1-phase)]	Siemens	Sensation 64	[Body]	120.0 kV	1.0 s	1.0	18mm
☐	2019/04/01 00:00	00136272	00139824	Head[Head-Neck (1-phase)]	GE	Revolution CT	[Head]	120.0 kV	1.5 s	1.2	256x0.

Delete the marked data | Merge selected data

Fig. 6-5. Page of history of your calculation（merge of the calculation results）

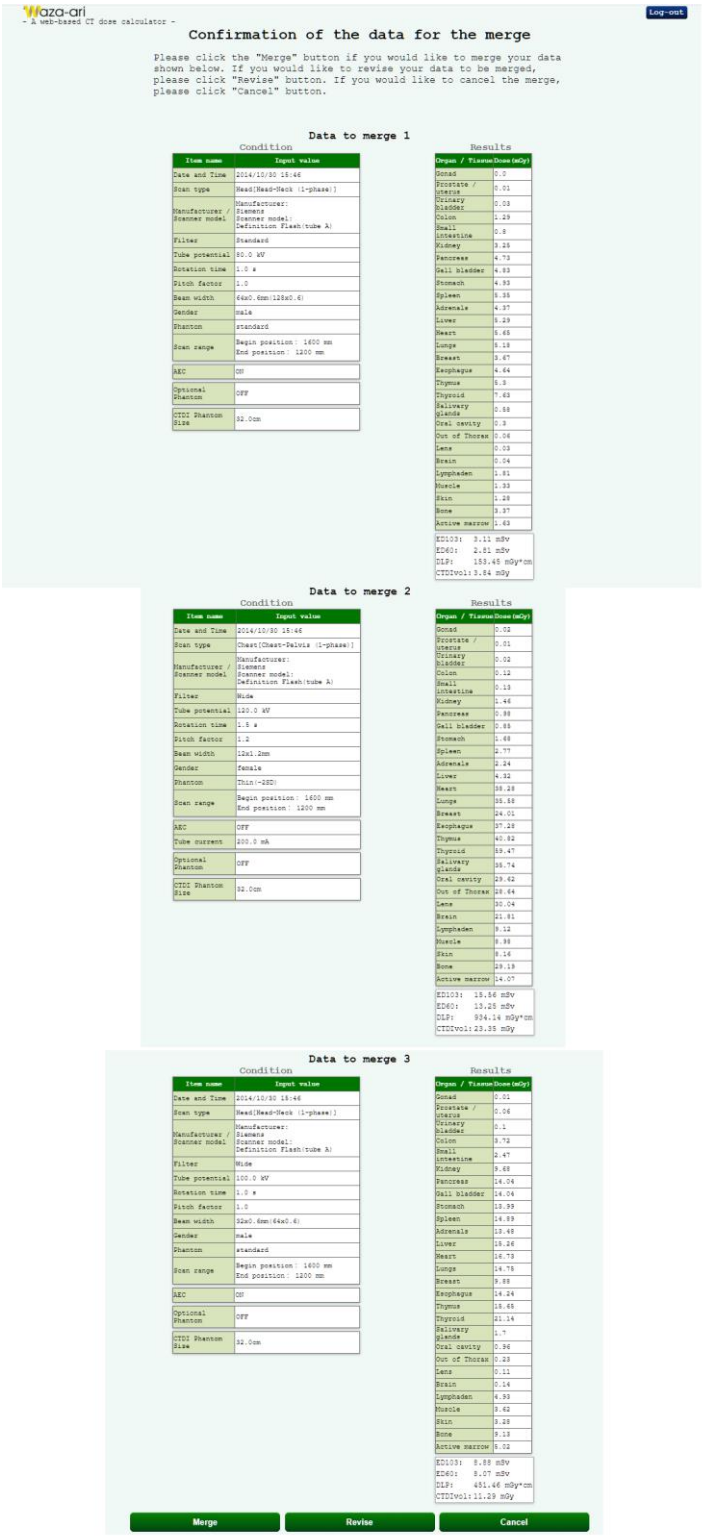


Fig. 6-6. Page for confirming the merged data

Select for deletion	Date and Time	Study ID	Series ID	Scan type	Manufacturer	Scanner model	Filter	Tube potential	Rotation time	Pitch factor	
☐	2018/12/06 15:12	00033160	00035251	Pelvis[Pelvis]	GE	LightSpeed VCT	Small	120.0 kV	0.5 s	1.0	20mm
☐	2018/12/10 14:50	00033178	00035269	Chest[Chest-Pelvis (1-phase)]	Philips	Brilliance iCT	Large	120.0 kV	0.5 s	1.0	16x0
☑	2014/10/30 15:46	00034215	00037144	Head[Head-Neck (1-phase)]	Siemens	Definition Flash(tube A)	Standard	80.0 kV	1.0 s	1.0	64x0
☑	2014/10/30 15:46	00034216	00037145	Chest[Chest-Pelvis (1-phase)]	Siemens	Definition Flash(tube A)	Wide	120.0 kV	1.5 s	1.2	12x1
☐	2014/10/30 15:46	00034217	00037146	Neck[Neck-Pelvis (1-phase)]	GE	LightSpeed 16	Large	120.0 kV	1.0 s	1.2	20mm
☑	2014/10/30 15:46	00034227	00037170	Head[Head-Neck (1-phase)]	Siemens	Definition Flash(tube A)	Wide	100.0 kV	1.0 s	1.0	32x0
☐	2014/10/30 15:46	00034228	00037171	Neck[Neck-Pelvis (1-phase)]	Canon	Aquilion ONE(TSX-301)	Large	135.0 kV	1.5 s	1.2	2mm
☐	2014/10/30 15:46	00034229	00037172	Neck[Neck-Pelvis (1-phase)]	Philips	Brilliance iCT	Large	120.0 kV	1.0 s	1.2	32x0
☐	2019/04/01 00:00	00136271	00139823	Chest[Chest-Pelvis (1-phase)]	Siemens	Sensation 64	[Body]	120.0 kV	1.0 s	1.0	18mm
☐	2019/04/01 00:00	00136272	00139824	Head[Head-Neck (1-phase)]	GE	Revolution CT	[Head]	120.0 kV	1.5 s	1.2	256x

Select for deletion	Date and Time	Study ID	Series ID	Scan type	Manufacturer	Scanner model	Filter	Tube potential	Rotation time	Pitch factor	
☐	2018/12/06 15:12	00033160	00035251	Pelvis[Pelvis]	GE	LightSpeed VCT	Small	120.0 kV	0.5 s	1.0	20mm
☐	2018/12/10 14:50	00033178	00035269	Chest[Chest-Pelvis (1-phase)]	Philips	Brilliance iCT	Large	120.0 kV	0.5 s	1.0	16x0
☑	2014/10/30 15:46	00033178	00037144	Head[Head-Neck (1-phase)]	Siemens	Definition Flash(tube A)	Standard	80.0 kV	1.0 s	1.0	64x0
☑	2014/10/30 15:46	00033178	00037145	Chest[Chest-Pelvis (1-phase)]	Siemens	Definition Flash(tube A)	Wide	120.0 kV	1.5 s	1.2	12x1
☐	2014/10/30 15:46	00034217	00037146	Neck[Neck-Pelvis (1-phase)]	GE	LightSpeed 16	Large	120.0 kV	1.0 s	1.2	20mm
☑	2014/10/30 15:46	00033178	00037170	Head[Head-Neck (1-phase)]	Siemens	Definition Flash(tube A)	Wide	100.0 kV	1.0 s	1.0	32x0
☐	2014/10/30 15:46	00034228	00037171	Neck[Neck-Pelvis (1-phase)]	Canon	Aquilion ONE(TSX-301)	Large	135.0 kV	1.5 s	1.2	2mm
☐	2014/10/30 15:46	00034229	00037172	Neck[Neck-Pelvis (1-phase)]	Philips	Brilliance iCT	Large	120.0 kV	1.0 s	1.2	32x0
☐	2019/04/01 00:00	00136271	00139823	Chest[Chest-Pelvis (1-phase)]	Siemens	Sensation 64	[Body]	120.0 kV	1.0 s	1.0	18mm
☐	2019/04/01 00:00	00136272	00139824	Head[Head-Neck (1-phase)]	GE	Revolution CT	[Head]	120.0 kV	1.5 s	1.2	256x

Fig. 6-7. Change of the Study ID after merging data

6.2.2. **Dose evaluation for the same study (patient)**

You can search dose data in the history of your calculations and have the results displayed with the unit of Study ID by choosing list to display "by study" as it shown in Fig. 6-8. In that case, the organ dose for the same ID will be summed automatically for evaluation and the column of the scanning conditions will not be displayed.

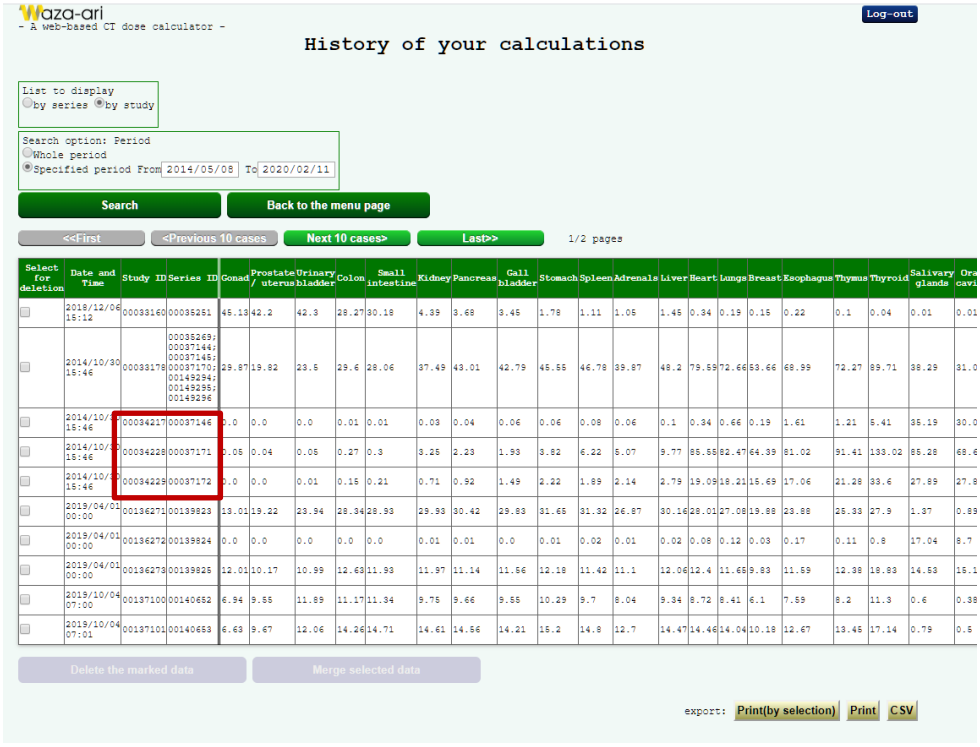


Fig. 6-8. Page for history of your calculation（displayed with history for the same study ID）

7.User model

Under construction

8.Confirmation of dose distribution

You can review all registered calculation results using this function. Accordingly, print, delete and exportation of the registered data are also available. Pressing "Dose distributions" button on the Main menu (Fig. 8-1) to go to the page of "Register the number of X-ray CT examination".

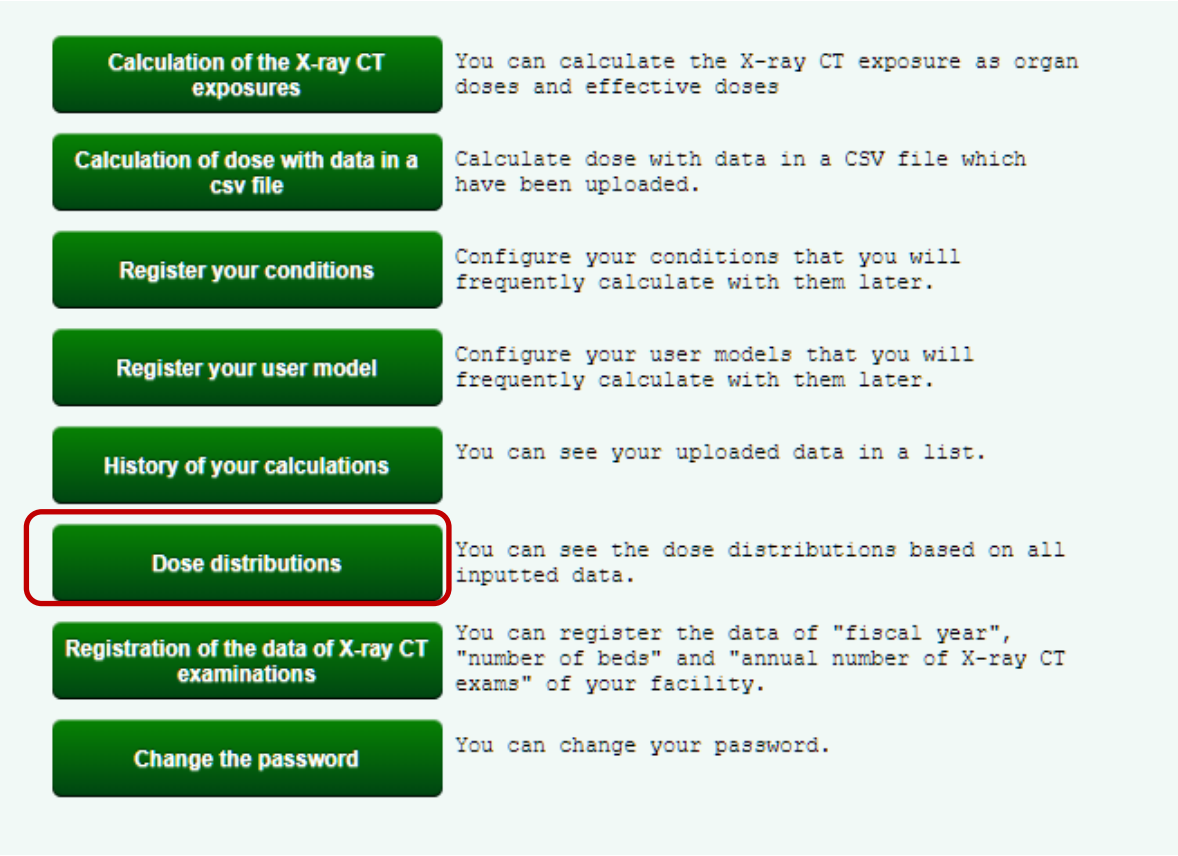


Fig. 8-1 Main menu（Dose distributions）

Specify each condition on the page for displaying in dose distribution (Fig. 8-2) and press "Show the graph" button to check browse dose distribution of registered data as a histogram. (Fig. 8-3andFig. 8-4).

If you choose "All facilities" for the data for the search you will see light green and dark green in your graph and the meaning is as follows,

Light green: All the dose data in the WAZA-ARIv2

Dark green: Dose data registered by your institution

Accordingly, median of each data is displayed as the statistical level value of the histogram.

You can specify the tissue types and CT examination type of dose information to display. If you want to specify more than one type, press "Ctrl" on the keyboard while you select.

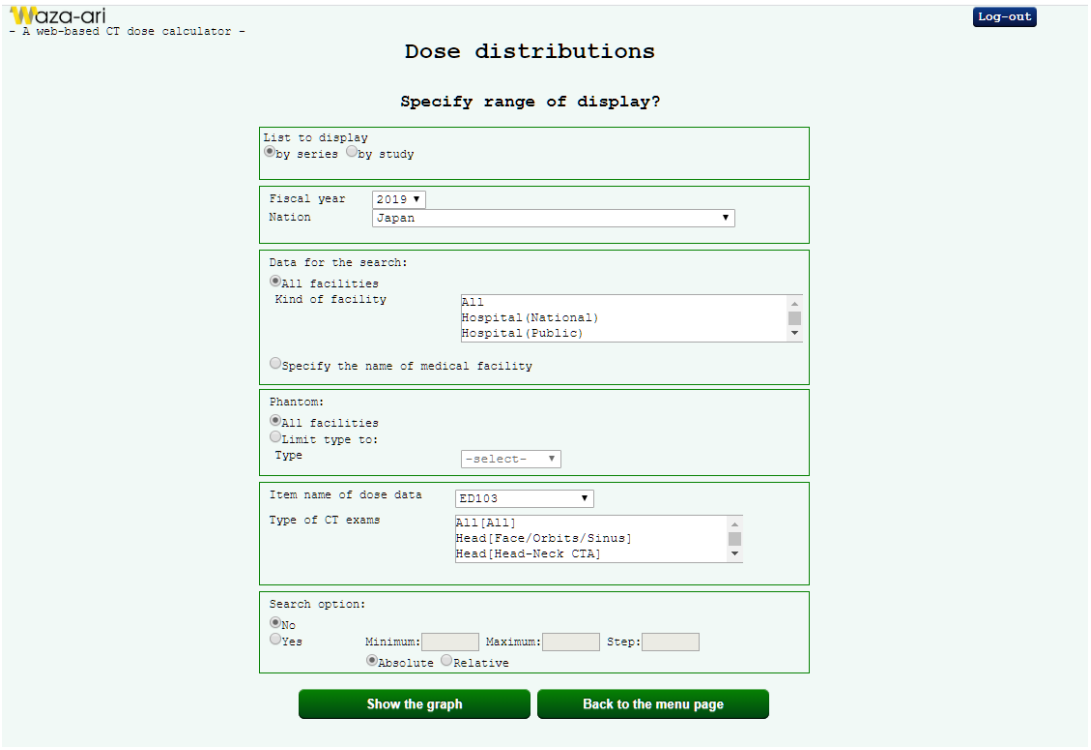


Fig. 8-2 Page for specifying the information of dose distribution

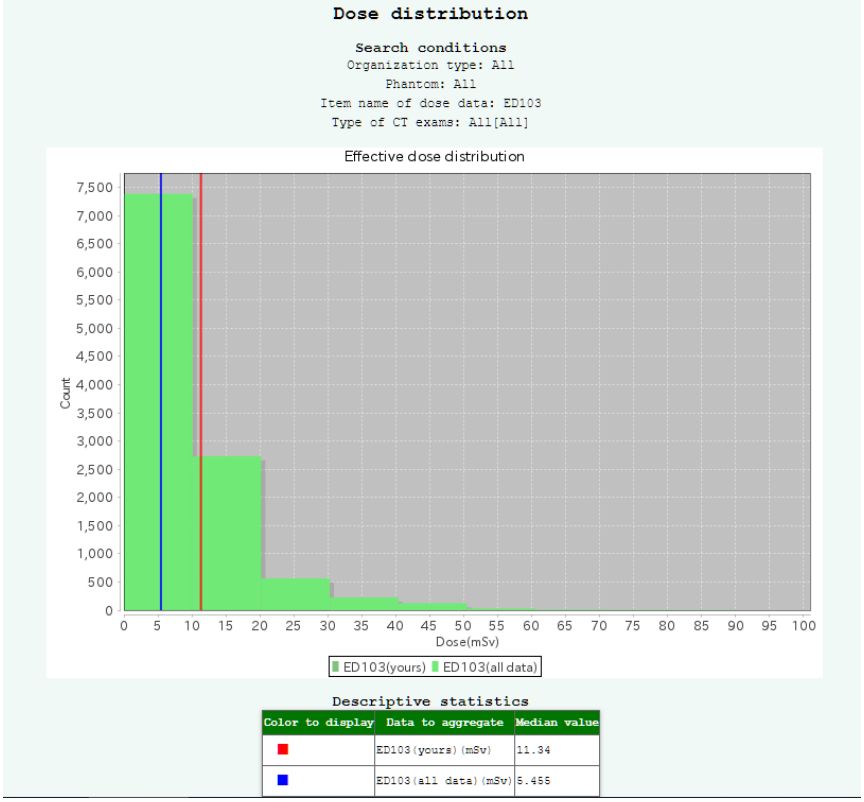


Fig. 8-3 Histogram of dose distribution（Absolute）

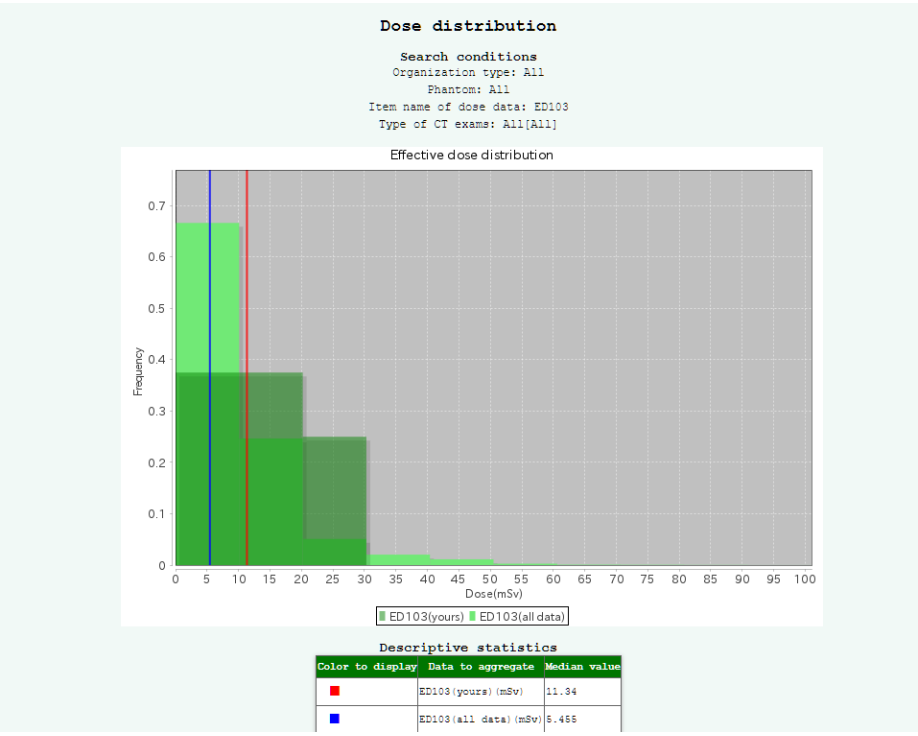


Fig. 8-4 Histogram of dose distribution（Relative）

9.Dose calculation method

9.1. **Construction of organ dose database for each CT source data**

WAZA-ARI calculates exposure dose using organ dose database for each CT model, tube voltage, Bow-tie filter, and phantom. This organ dose database is constructed using general-purpose particle / heavy ion transport calculation codes PHITS developed by the JAEA and various human Voxel phantoms.

After measuring source data (such as HVL and dose distribution) for each CT model, tube voltage, Bow-tie filter and collimation X-ray energy spectrum and generation distribution are modeled based on the measurement, and the model is implemented into PHITS as an X-ray source. Accordingly, using PHITS and the human body voxel phantom to calculate dose to each organ for each slice of phantom. [1,2]

In PHITS, absorbed dose to organ *T* per generated photon at slice *k* $qD(T,k)$ [mGy / photon] and air kerma at the center of rotation per generated photon qK_{air} [mGy / photon] (=$CTDI_{free\ air}$per generated photon) are calculated for each CT model, tube voltage, Bow-tie filter, and phantom and implemented in WAZA-ARI system as described above. Absorbed dose to organ *T* at *k*-th slice $_nD(T,k)$ [mGy / mGy] per $CTDI_{free\ air}$ is then calculated by

$$_nD(T,k) = \frac{qD(T,k)}{qK_{air}}.$$

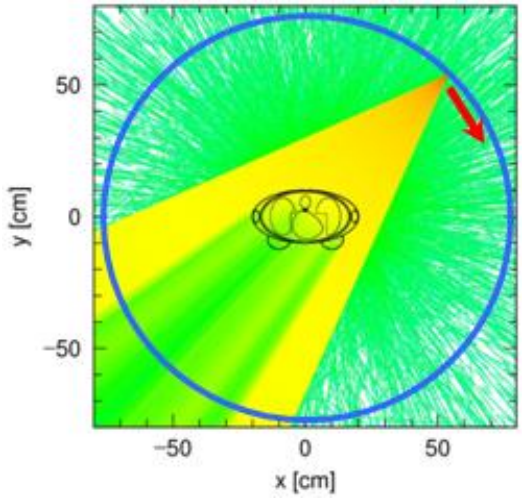


Fig. 9-1. Example of how X-ray emitted from CT device using PHITS

In WAZA-ARI, CT models with similar beam quality and dose distribution are calculated using the same source data while dose information such as $CTDI_w$ and $CTDI_{free\ air}$ are referring the nominal values of each model.

9.2. **Organ dose database and the computable range**

Organ dose database is the calculated radiation dose data for each organ within an interval of 5 mm (= 1 slice). Table 9-1 shows the content of organ dose database.

Table 9-1 Content of organ dose database

Phantom	Male	Female
standard **Fat(+2SD)** **Fat(+5SD)** **Thin(-2SD)**	0 – 1835 (367 slice)	0 – 1666 (334 slice)
age:0	0 - 475 mm (95 slice)	0 - 475 mm (95 slice)
age:1	0 - 765 mm (153 slice)	0 - 765 mm (153 slice)
age:5	0 - 1105 mm (221 slice)	0 - 1105 mm (221 slice)
age:10	0 – 1400 mm (280 slice)	0 – 1400 mm (280 slice)
age:15	0 – 1660 mm (332 slice)	0 – 1615 mm (323 slice)

9.3. **Parameter and data for dose calculation**

Organ dose calculation for each scanning condition needs the following parameter.

Beginning position z_{start} [mm] and the end position z_{end} [mm] of scan

Tube current I [mA]

Rotation time t [s]

Beam pitch pit [-]

normalized CTDI free air $_nCTDI_{free\,air}$ [mGy/mAs]

$_nCTDI_{free\,air}$ means CTDI free air per mAs which varies with tube current, Bow-tie filter and beam width.

normalized Weighted CTDI $_nCTDI_w$ [mGy/mAs]

$CTDI_w$ is the summation of weighted central dose in CTDI phantom (16 cm ϕ for head and 32 cm ϕ for body) $CTDI_{center}$ and the peripheral dose in CTDI phantom $CTDI_{peripheral}$.

$$CTDI_w = \frac{1}{3}CTDI_{center} + \frac{2}{3}CTDI_{peripherl} \quad (1)$$

$_nCTDI_w$ is $CTDI_w$ per mAs and it varies with tube voltage and beam width.

9.4. **Calculation of organ dose**

AEC（Auto Exposure Control）: off

Couch movement during one rotation of the beam is $w \cdot pit$, and irradiated area is equal to the beam width w during one rotation. Therefore, percentage of the body surface with incident of primary X-rays can be expressed as follows.

$$\frac{w}{w \cdot pit} = \frac{1}{pit}$$

$\frac{1}{pit} > 1$ means that this part is multiple irradiations.

Irradiation of *k*th slice results in dose for the organ T$D(T,k)$ [mGy] is as follows

$$D(T,k)[\mathrm{mGy}] = {}_nD(T,k)[\mathrm{mGy/mGy}] \cdot {}_nCTDI_{free\ air}[\mathrm{mGy/mAs}] \cdot \frac{I \cdot t}{pit}[\mathrm{mAs}] \qquad (2)$$

${}_nD(T,k)$ is pre-calculated for different CT scanner, tube voltage, Bow-tie filter and phantom with an interval $\Delta s = 5\ \mathrm{mm}$.

As shown in Fig 9-2, absorbed dose D to tissue T $D(T)$ that located in scanning range of z_{start}~z_{end} $(z_{start} < z_{end})$ [mm] is calculated as follows.

$$D(T) = \int_{z_{start}}^{z_{end}} \frac{D(T,k)}{\Delta s} dz = \frac{z_{i+1} - z_{start}}{\Delta s} D(T,i) + \sum_{k=i+1}^{j-1} D(T,k) + \frac{z_{end} - z_j}{\Delta s} D(T,i) \qquad (3)$$

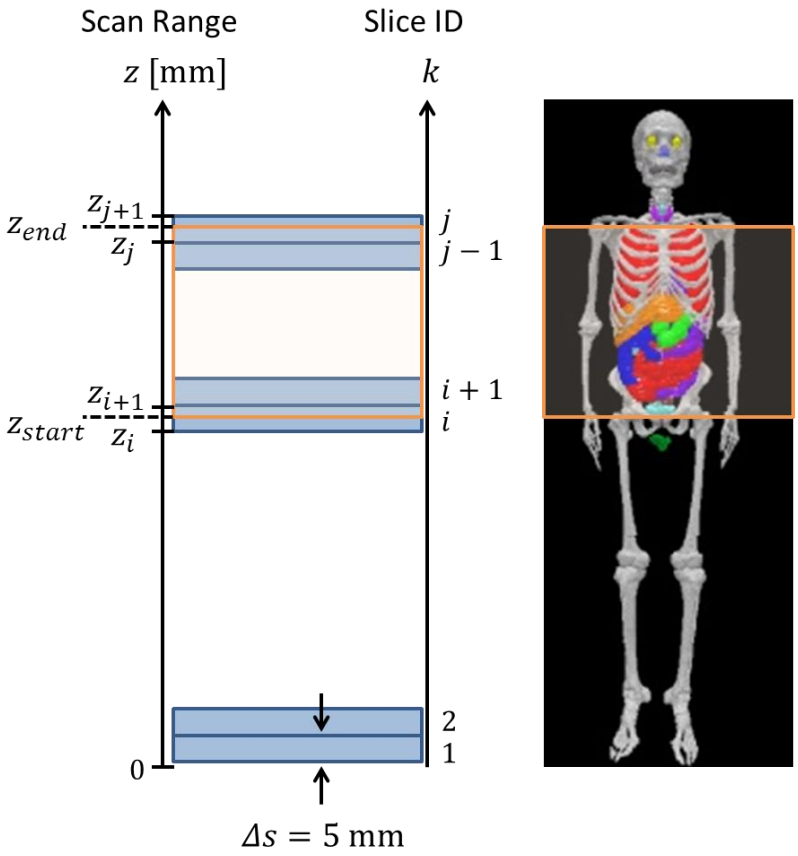


Fig 9-2. Relationship between the scanning range of z_{start}~z_{end} and organ dose data for *k*th slice

AEC（Auto Exposure Control）: on

When AEC function is on, it is assumed that tube current I [mA] changes according to z-coordinate of the irradiation position as shown in Fig. 9-3. Tube current values $I_{start}, I_{end}, I_a, I_b, I_{c'}(=I_b), I_c, I_d, I_e$ corresponding to the beginning/end position of scanning z_{start}, z_{end} and boundary position $z_a, z_b, z_{c'}, z_c, z_d, z_e$ can be specified by the user. Tube current at the center of each slice I_k ($\Delta s = 5$ mm) within the scanning range is calculated based on the tube voltage. Boundary positions are shown in Table 9-2 and Table 9-3.

When the coordinates $z_k + \frac{\Delta s}{2}$ of the center of the k-th slice are between adjacent boundary positions z_l, z_m, tube current I_k is expressed by linear interpolation as shown in the following formula.

$$I_k = I_l + \frac{I_m - I_l}{z_m - z_l}\left(z_k + \frac{\Delta s}{2} - z_l\right) \quad \left(z_l < z_k + \frac{\Delta s}{2} < z_m\right) \qquad (4)$$

On the assumption that I_k is constant within each slice, absorbed dose *D* to organ T from the irradiation of the *k*th slice $D(T,k)$ is calculated as follows.

$$D(T,k)[\mathrm{mGy}] = {}_nD(T,k)[\mathrm{mGy/mGy}] \cdot {}_nCTDI_{free\ air}[\mathrm{mGy/mAs}] \cdot \frac{I_k \cdot t}{pit}[\mathrm{mAs}] \qquad (5)$$

Absorbed dose to tissue T $D(T)$ within the scan area is calculated by Eq. (6).

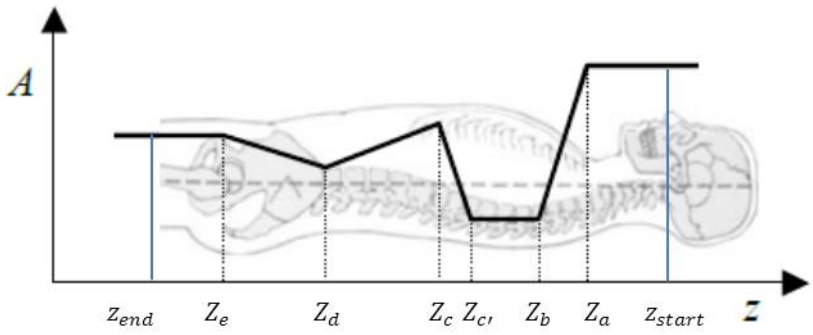


Fig. 9-3. Change of tube current when AEC is on

Table 9-2 Boundary for male phantom when using AEC calculation

z	Anatomical definition	Adult male [mm]	0-year-old boy [mm]	1-year-old boy [mm]	5-year-old boy [mm]	10-year-old boy [mm]	15-year-old boy [mm]
Z_a	First slice of lung apex	1542.5	337.5	575.5	885.5	1156.5	1394.5
Z_b	Trachea	1452.5	319.5	550.5	843.5	1100.5	1324.5
$Z_{c'}$ $(Z_{c'} - Z_c)$		1322.5 (50)	297.5 (20)	493.5 (20)	774.5 (20)	1019.5 (20)	1190.5 (20)
Z_c	Hepatic portal section (Last slice for left lung field)	1272.5	277.5	473.5	754.5	999.5	1170.5
Z_d	Upper margin of iliac	1150.5	200.5	377.5	614.5	823.5	1010.5
Z_e	Upper margin of pubis	987.5	164.5	306.5	517.5	686.5	849.5

Table 9-3 Boundary for male phantom when using AEC calculation

z	Anatomical definition	Adult female [mm]	0-year-old girl [mm]	1-year-old girl [mm]	5-year-old girl [mm]	10-year-old girl [mm]	15-year-old girl [mm]
Z_a	First slice of lung apex	1404.5	337.5	575.5	885.5	1156.5	1345.5
Z_b	Trachea	1311.5	319.5	550.5	843.5	1100.5	1269.5
$Z_{c'}$ $(Z_{c'} - Z_c)$		1181.5 (50)	297.5 (20)	493.5 (20)	774.5 (20)	1019.5 (20)	1164.5 (20)
Z_c	Hepatic portal section (Last slice for left lung field)	1131.5	277.5	473.5	754.5	999.5	1144.5
Z_d	Upper margin of iliac	1028.5	200.5	377.5	614.5	823.5	975.5
Z_e	Upper margin of pubis	861.5	164.5	306.5	517.5	686.5	818.5

9.5. **Calculation of dose index**

WAZA-ARI calculates DLP (Dose Length Product) and averaged $CTDI_{vol}$ for the scanning area as dose indexes.

AEC（Auto Exposure Control）: off

$$CTDI_{vol}[\mathrm{mGy}] = {}_nCTDI_w \cdot \frac{I \cdot t}{pit}$$

$$DLP[\mathrm{mGy \cdot cm}] = CTDI_{vol}[\mathrm{mGy}] \cdot (z_{end} - z_{start})\ [\mathrm{mm}] \cdot \frac{1}{10}[\frac{\mathrm{cm}}{\mathrm{mm}}]$$

AEC（Auto Exposure Control）: on

$CTDI_{vol}$ for *k*th slice $CTDI_{vol}(k)$ is expressed as:

$$CTDI_{vol}(k)[\mathrm{mGy}] = Rel\_CTDI \cdot {}_nCTDI_w \cdot \frac{I_k \cdot t}{pit}$$

When the scanning range is between z_{start}~z_{end} $(z_{start} < z_{end})$ shown in Fig 9-2, DLP [mGy・cm] can be expressed as

$$DLP[\mathrm{mGy \cdot cm}] = \left\{ (z_{i+1} - z_{start}) \cdot CTDI_{vol}(i) + \Delta s \cdot \sum_{k=i+1}^{j-1} CTDI_{vol}(k) + \left(z_{end} - z_j\right) \cdot CTDI_{vol}(j) \right\} [\mathrm{mGy}$$

$$\cdot \mathrm{mm}] \cdot \frac{1}{10}[\mathrm{cm/mm}]$$

Averaged $CTDI_{vol}$ [mGy] can be expressed as:

$$CTDI_{vol}[\mathrm{mGy}] = \frac{DLP[\mathrm{mGy \cdot cm}]}{(z_{end} - z_{start})[\mathrm{mm}]} \cdot 10[\mathrm{mm/cm}]$$

SSDE（Size-specific Dose Estimates）: on

SSDE is a dose index proposed to correct the uncertainty of $CTDI_{vol}$. WAZA-ARIv2 calculates SSDE by using the conversion factors, i.e. f_{size}^{16} or f_{size}^{32}, and the following formula proposed in AAPM report TG204 [7].

If $CTDI_{vol}$ was calculated based on a 32 cm CTDI phantom:

$$SSDE = f_{size}^{32} \times CTDI_{vol}^{32}\ [\mathrm{mGy}]$$

If $CTDI_{vol}$ was calculated based on a 16 cm CTDI phantom:

$$SSDE = f_{size}^{16} \times CTDI_{vol}^{16}\ [\mathrm{mGy}]$$

Table 9-4 Conversion factor f_{size}^{32} as a function of effective diameter

Effective diameter	Conversion factor	Effective diameter	Conversion factor	Effective diameter	Conversion factor
8	2.76	21	1.71	34	1.06
9	2.66	22	1.65	35	1.02
10	2.57	23	1.59	36	0.99
11	2.47	24	1.53	37	0.95
12	2.38	25	1.48	38	0.92
13	2.30	26	1.43	39	0.88
14	2.22	27	1.37	40	0.85
15	2.14	28	1.32	41	0.82
16	2.06	29	1.28	42	0.79
17	1.98	30	1.23	43	0.76
18	1.91	31	1.19	44	0.74
19	1.84	32	1.14	45	0.71
20	1.78	33	1.10		

Table 9-5 Conversion factor f_{size}^{16} as a function of effective diameter

Effective diameter [cm]	Conversion factor	Effective diameter [cm]	Conversion factor	Effective diameter [cm]	Conversion factor
6	1.49	23	0.77	40	0.40
7	1.43	24	0.74	41	0.38
8	1.38	25	0.71	42	0.37
9	1.32	26	0.69	43	0.35
10	1.27	27	0.66	44	0.34
11	1.22	28	0.63	45	0.33
12	1.18	29	0.61	46	0.32
13	1.13	30	0.59	47	0.30
14	1.09	31	0.56	48	0.29
15	1.05	32	0.54	49	0.28
16	1.01	33	0.52	50	0.27
17	0.97	34	0.50	51	0.26
18	0.93	35	0.48	52	0.25
19	0.90	36	0.47	53	0.24
20	0.86	37	0.45	54	0.23
21	0.83	38	0.43	55	0.22
22	0.80	39	0.41		

10. Registered parameters

Table 10-1 Scan position and range for each scan type: Age-0 M/F

Body region	Scan parameter	Begin	End	Range (mm)
Head	Routine Head (non-helical)	475	390	85
	Routine Head (helical)	475	390	85
	Head-Neck (1-phase)	475	330	145
	Head CTA	475	355	120
	Head-Neck CTA	475	330	145
	Face/Orbits/Sinus	440	355	85
Neck	Routine Neck (1-phase)	390	345	45
	Neck-Chest (1-phase)	390	260	130
	Neck-Abdomen (1-phase)	390	220	170
	Neck-Pelvis (1-phase)	390	140	250
Chest	Routine Chest (1-Phase)	370	260	110
	HRCT	370	260	110
	Chest-upper Abdomen (1-phase)	370	220	150
	Chest-Pelvis (1-phase)	370	140	230
	Lung nodule (1-phase)	370	260	110
Abdomen	Upper Abdomen (1-phase)	300	220	80
	Abdomen-Pelvis (1-phase)	300	140	160
	Multi-phase Liver	300	215	85
Pelvis	Pelvis	240	140	100
	Lower Abdomen	240	140	100
	Hip	195	145	50
Spine	C-spine	395	345	50
	T-spine	370	240	130
	L-spine	280	190	90
Cardiac	Coronary CTA	330	280	50

Table 10-2 Scan position and range for each scan type: Age-1 M/F

Body region	Scan parameter	Begin	End	Range (mm)
Head	Routine Head (non-helical)	765	650	115
	Routine Head (helical)	765	650	115
	Head-Neck (1-phase)	765	555	210
	Head CTA	765	600	165
	Head-Neck CTA	765	555	210
	Face/Orbits/Sinus	720	600	120
Neck	Routine Neck (1-phase)	650	565	85
	Neck-Chest (1-phase)	650	425	225
	Neck-Abdomen (1-phase)	650	380	270
	Neck-Pelvis (1-phase)	650	280	370
Chest	Routine Chest (1-Phase)	600	425	175
	HRCT	600	425	175
	Chest-upper Abdomen (1-phase)	600	380	220
	Chest-Pelvis (1-phase)	600	280	320
	Lung nodule (1-phase)	600	425	175
Abdomen	Upper Abdomen (1-phase)	495	380	115
	Abdomen-Pelvis (1-phase)	495	280	215
	Multi-phase Liver	495	375	120
Pelvis	Pelvis	405	280	125
	Lower Abdomen	405	280	125
	Hip	345	285	60
Spine	C-spine	655	565	90
	T-spine	600	410	190
	L-spine	470	350	120
Cardiac	Coronary CTA	550	470	80

Table 10-3 Scan position and range for each scan type: Age-5 M/F

Body region	Scan parameter	Begin	End	Range (mm)
Head	Routine Head (non-helical)	1100	975	125
	Routine Head (helical)	1400	1270	130
	Head-Neck (1-phase)	1400	1135	265
	Head CTA	1400	1200	200
	Head-Neck CTA	1400	1135	265
	Face/Orbits/Sinus	1350	1200	150
Neck	Routine Neck (1-phase)	1270	1140	130
	Neck-Chest (1-phase)	1270	920	350
	Neck-Abdomen (1-phase)	1270	860	410
	Neck-Pelvis (1-phase)	1270	635	635
Chest	Routine Chest (1-Phase)	1180	920	260
	HRCT	1180	920	260
	Chest-upper Abdomen (1-phase)	1180	860	320
	Chest-Pelvis (1-phase)	1180	635	545
	Lung nodule (1-phase)	1180	920	260
Abdomen	Upper Abdomen (1-phase)	1020	860	160
	Abdomen-Pelvis (1-phase)	1020	635	385
	Multi-phase Liver	1020	865	155
Pelvis	Pelvis	860	635	225
	Lower Abdomen	860	635	225
	Hip	740	650	90
Spine	C-spine	1280	1140	140
	T-spine	1180	900	280
	L-spine	950	745	205
Cardiac	Coronary CTA	1120	990	130

Table 10-4 Scan position and range for each scan type: Age-10 M/F

Body region	Scan parameter	Begin	End	Range (mm)
Head	Routine Head (non-helical)	1400	1270	130
	Routine Head (helical)	1400	1270	130
	Head-Neck (1-phase)	1400	1135	265
	Head CTA	1400	1200	200
	Head-Neck CTA	1400	1135	265
	Face/Orbits/Sinus	1350	1200	150
Neck	Routine Neck (1-phase)	1270	1140	130
	Neck-Chest (1-phase)	1270	920	350
	Neck-Abdomen (1-phase)	1270	860	410
	Neck-Pelvis (1-phase)	1270	635	635
Chest	Routine Chest (1-Phase)	1180	920	260
	HRCT	1180	920	260
	Chest-upper Abdomen (1-phase)	1180	860	320
	Chest-Pelvis (1-phase)	1180	635	545
	Lung nodule (1-phase)	1180	920	260
Abdomen	Upper Abdomen (1-phase)	1020	860	160
	Abdomen-Pelvis (1-phase)	1020	635	385
	Multi-phase Liver	1020	865	155
Pelvis	Pelvis	860	635	225
	Lower Abdomen	860	635	225
	Hip	740	650	90
Spine	C-spine	1280	1140	140
	T-spine	1180	900	280
	L-spine	950	745	205
Cardiac	Coronary CTA	1120	990	130

Table 10-5 Scan position and range for each scan type: Age-15 Male

Body region	Scan parameter	Begin	End	Range (mm)
Head	Routine Head (non-helical)	1660	1530	130
	Routine Head (helical)	1660	1530	130
	Head-Neck (1-phase)	1660	1370	290
	Head CTA	1660	1445	215
	Head-Neck CTA	1660	1370	290
	Face/Orbits/Sinus	1620	1445	175
Neck	Routine Neck (1-phase)	1525	1365	160
	Neck-Chest (1-phase)	1525	1140	385
	Neck-Abdomen (1-phase)	1525	1010	515
	Neck-Pelvis (1-phase)	1525	790	735
Chest	Routine Chest (1-Phase)	1420	1140	280
	HRCT	1420	1140	280
	Chest-upper Abdomen (1-phase)	1420	1010	410
	Chest-Pelvis (1-phase)	1420	790	630
	Lung nodule (1-phase)	1420	1140	280
Abdomen	Upper Abdomen (1-phase)	1215	1010	205
	Abdomen-Pelvis (1-phase)	1215	790	425
	Multi-phase Liver	1215	1015	200
Pelvis	Pelvis	1050	790	260
	Lower Abdomen	1050	790	260
	Hip	910	790	120
Spine	C-spine	1540	1365	175
	T-spine	1420	1100	320
	L-spine	1200	920	280
Cardiac	Coronary CTA	1360	1185	175

Table 10-6 Scan position and range for each scan type: Age-15 Female

Body region	Scan parameter	Begin	End	Range (mm)
Head	Routine Head (non-helical)	1600	1485	115
	Routine Head (helical)	1600	1485	115
	Head-Neck (1-phase)	1600	1320	280
	Head CTA	1600	1405	195
	Head-Neck CTA	1600	1320	280
	Face/Orbits/Sinus	1550	1405	145
Neck	Routine Neck (1-phase)	1480	1325	155
	Neck-Chest (1-phase)	1480	1080	400
	Neck-Abdomen (1-phase)	1480	1015	465
	Neck-Pelvis (1-phase)	1480	770	710
Chest	Routine Chest (1-Phase)	1370	1080	290
	HRCT	1370	1080	290
	Chest-upper Abdomen (1-phase)	1370	1015	355
	Chest-Pelvis (1-phase)	1370	770	600
	Lung nodule (1-phase)	1370	1080	290
Abdomen	Upper Abdomen (1-phase)	1190	1015	175
	Abdomen-Pelvis (1-phase)	1190	770	420
	Multi-phase Liver	1190	800	390
Pelvis	Pelvis	1000	770	230
	Lower Abdomen	1000	770	230
	Hip	880	770	110
Spine	C-spine	1490	1325	165
	T-spine	1370	1050	320
	L-spine	1160	900	260
Cardiac	Coronary CTA	1310	1145	165

Table 10-7 Scan position and range for each scan type: Adult Male

Body region	Scan parameter	Begin	End	Range (mm)
Head	Routine Head (non-helical)	1835	1700	135
	Routine Head (helical)	1835	1700	135
	Head-Neck (1-phase)	1835	1510	325
	Head CTA	1835	1600	235
	Head-Neck CTA	1835	1510	325
	Face/Orbits/Sinus	1785	1600	185
Neck	Routine Neck (1-phase)	1700	1525	175
	Neck-Chest (1-phase)	1700	1230	470
	Neck-Abdomen (1-phase)	1700	1150	550
	Neck-Pelvis (1-phase)	1700	920	780
Chest	Routine Chest (1-Phase)	1580	1230	350
	HRCT	1580	1230	350
	Chest-upper Abdomen (1-phase)	1580	1150	430
	Chest-Pelvis (1-phase)	1580	920	660
	Lung nodule (1-phase)	1580	1230	350
Abdomen	Upper Abdomen (1-phase)	1350	1150	200
	Abdomen-Pelvis (1-phase)	1350	920	430
	Multi-phase Liver	1350	1165	185
Pelvis	Pelvis	1180	920	260
	Lower Abdomen	1180	920	260
	Hip	1080	910	170
Spine	C-spine	1700	1525	175
	T-spine	1580	1190	390
	L-spine	1340	1060	280
Cardiac	Coronary CTA	1450	1265	185

Table 10-8 Scan position and range for each scan type: Adult Female

Body region	Scan parameter	Begin	End	Range (mm)
Head	Routine Head (non-helical)	1665	1550	115
	Routine Head (helical)	1665	1550	115
	Head-Neck (1-phase)	1665	1380	285
	Head CTA	1665	1445	220
	Head-Neck CTA	1665	1380	285
	Face/Orbits/Sinus	1625	1455	170
Neck	Routine Neck (1-phase)	1540	1370	170
	Neck-Chest (1-phase)	1540	1110	430
	Neck-Abdomen (1-phase)	1540	1010	530
	Neck-Pelvis (1-phase)	1540	820	720
Chest	Routine Chest (1-Phase)	1435	1110	325
	HRCT	1435	1110	325
	Chest-upper Abdomen (1-phase)	1435	1010	425
	Chest-Pelvis (1-phase)	1435	820	615
	Lung nodule (1-phase)	1435	1110	325
Abdomen	Upper Abdomen (1-phase)	1200	1010	190
	Abdomen-Pelvis (1-phase)	1200	820	380
	Multi-phase Liver	1200	1015	185
Pelvis	Pelvis	1050	820	230
	Lower Abdomen	1050	820	230
	Hip	930	810	120
Spine	C-spine	1545	1370	175
	T-spine	1435	1090	345
	L-spine	1200	930	270
Cardiac	Coronary CTA	1300	1140	160

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12. Index