VirtualDose^{TM} User Guide

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1. Introduction

The purpose of this document is to assist user how to use the VirtualDose Software. For the best use experience, we suggest you use Google Chrome web browser, or Internet Explorer 10.0 or newer.

2. Accessing the web-based VirtualDose™ Software Tools

VirtualDose™ can be accessed from a web browser, either through the Virtual Phantoms, Inc. website (http://www.virtualphantoms.com/virtualdose/) or directly at www.virtual-dose.com.
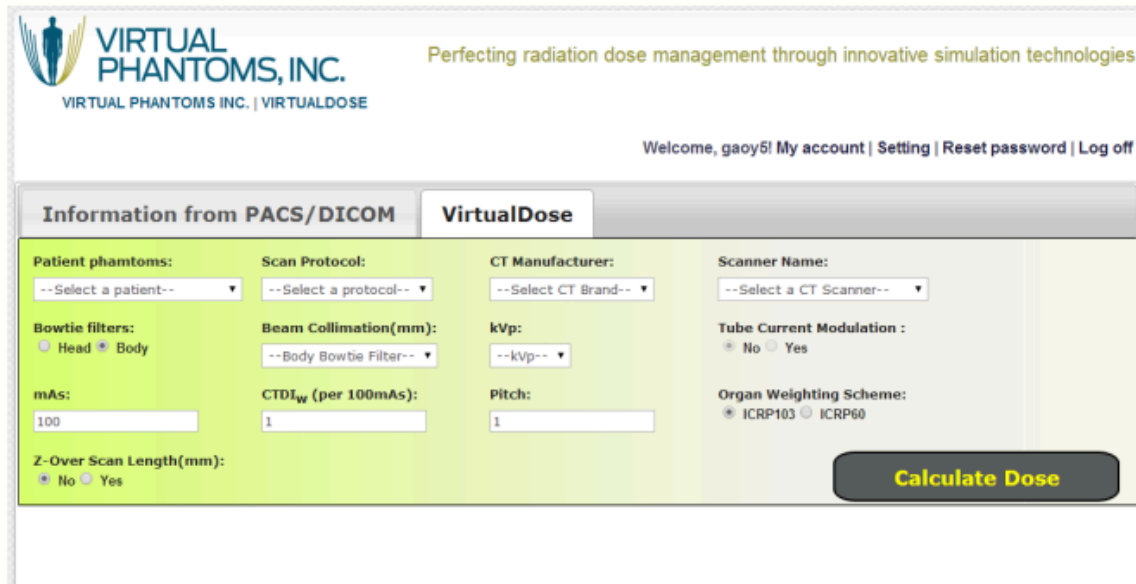

Figure 1. Virtual Phantom Inc. website

To access VirtualDose^{TM} software, users need a pre-assigned username and password. Click the "Log in" button, the login page will be loaded

Figure 2. "Log in" page

The VirtualDose system consists of two separate tools, **VirtualDoseCT**, for Computed Tomography dose, and **VirutalDoseIR**, for Interventional Radiology dose. An individual user account may have permission to use either or both tools.

If the "login" is successful, the main web-based interface will be displayed, depending upon the account permissions. The user interface of the VirtualDose^{TM} software tool is friendly and easy-to-use.

3. VirtualDoseCT Software Tool User Interface

Figure 3. VirtualDoseCT Software Tool User Interface

3.1 CT Parameter Inputs

There are several input parameters that are entered from the main interface, as shown in figure 3. The user selects or inputs these parameters of the CT scan before performing the patient dose calculation (some drop-down menus depend on previous choices, so it is generally best to enter values from left to right). The main components of the user interface include:

(1). Virtual Patients List

(2). Scan Protocols List

(3). Cross-section landmark images

(4). CT Scanner

(5). Bow Tie Filter Type

(6). Beam Collimations

(7). kVp

(8). mAs

(9). CTDIw

(10). Pitch

(11). Z-Over scan length

(12). Tissue weighting factors

Virtual patient

A user may select a "virtual patient" first from the "—Select a patient--" dropdown list. VirtualDose has 25 virtual patients in total, including 50th percentile adults named RPI-Adult-Male(RPI-AM) and RPI-Adult-Female (RPI-AF), pediatric patients of both male and female at different ages (newborn, 1-, 5-, 10-, and 15-year-old), pregnant females at three gestational stages (3-,6-, and 9-month), and a set of obese male and female patiets(normal-weight, over-weight, obese level-I, o bese level-II, and morbidly-obese). The user can select the one that is most close to the studied clinical case for more accurate patient dose calculation.

Scan protocol

The next step is to choose a scan protocol for the selected "Virtual Patient". User may select any one from the pre-defined protocols list, For example, select a "chest" scan from the dropdown list and the relevant scan range will then show above the "Virtual Patient" with a red color cover, as shown in Figure 7. Virtual dose provided 8 pre-defined protocols including head, neck, chest, abdomen, kidney, pelvis, abdomen-pelvis and CAP for the users to choose. If the protocol is not included in the 8 pre-defined protocols or the scan range define from the selected protocol is not consistent with the studied clinical case, the user can choose manually specify by using mouse to drag the green-colored sliders to specify the scan range on the "Virtual Patient", the cross-section images are

provided to help the user to define the start point and the end point of the scan better.

CT scanner

After specifying the scan range, user may select the CT scanner. First select a CT manufacturer from the dropdown list, manufacturers like GE, Siemens, Philips, Toshiba, Elscint and Picker are included in the list. Then choose the model of the CT scanner of the selected manufacturer from the scanner name dropdown list.

Bowtie filter

There are two types of bowtie filters, head and body. VirtualDose can choose the bowtie filter automatically based on the selected protocols. If "manually specify" were used to define the scan range, this user also need to double check the bowtie filter, usually head bowtie filter is used for head and neck scan, while body bowtie filter is used for any part of the trunk scan.

Beam Collimation & kVp

Beam Collimation & kVp can be selected from the dropdown list after the scanner is chosen. The beam collimation & kVp dropdown list will update automatically based on the available optiosn for the chosen scanner.

mAs

Enter the value for the average mAs per rotation in the scan. [TCM option is coming soon.]

CTDIw

CTDIw is an important parameter which represents the scanner output. This parameter can be measured with a pencil ion chamber and a CTDI phantom or acquired from the scanner console or CT DICOM files. Input the value of CTDIw per 100mAs in the text box.

Pitch

The value of pitch can be acquired from the scanner console or CT DICOM files, input the value the text box of pitch.

Tissue weighting factors

Two set of tissue weighting factors (ICRP103 and ICRP60) are provided, the user can choose one of them to calculate effective dose.

Z-Over scan length

If the user needs to consider Z-over scan length, just choose "Yes" and input the value of Z over scan for starting point and ending point respectively.
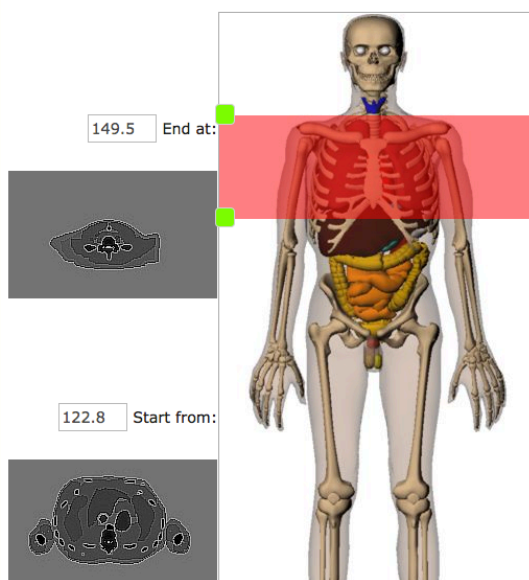
Figure 4 "Virtual Patient" shown within the browser

To calculate the CT dose based on above settings, user should click "Calculate Dose" button and the results will be immediately plotted and tabulated in the third tab of the main user interface, as shown in Figure 5.

Organs vs. Dose

Organ	Dose (mGy)
Uterus(F)/Prostate(M)	
Urinary Bladder	
Thyroid	
Thymus	
Stomach	
Spleen	
Small Intestine	
Skin	
Salivary Glands	
Remainder_103	
Red Bone Marrow	
Pancreas	
Oral Mucosa	
Muscle	
Lymphatic Nodes	
Lungs	
Liver	
Kidneys	
Heart	
Gonads	
Gall Bladder	
ET Region	
Esophagus	
Colon	
Breast	
Brain	
Bone Endosteum	
Adrenals	

Dose (mGy) axis: 0.0 1.8 3.5 5.3 7.1 8.8 10.6 12.4 14.2 15.9 17.7 19.5 21.2 23.0
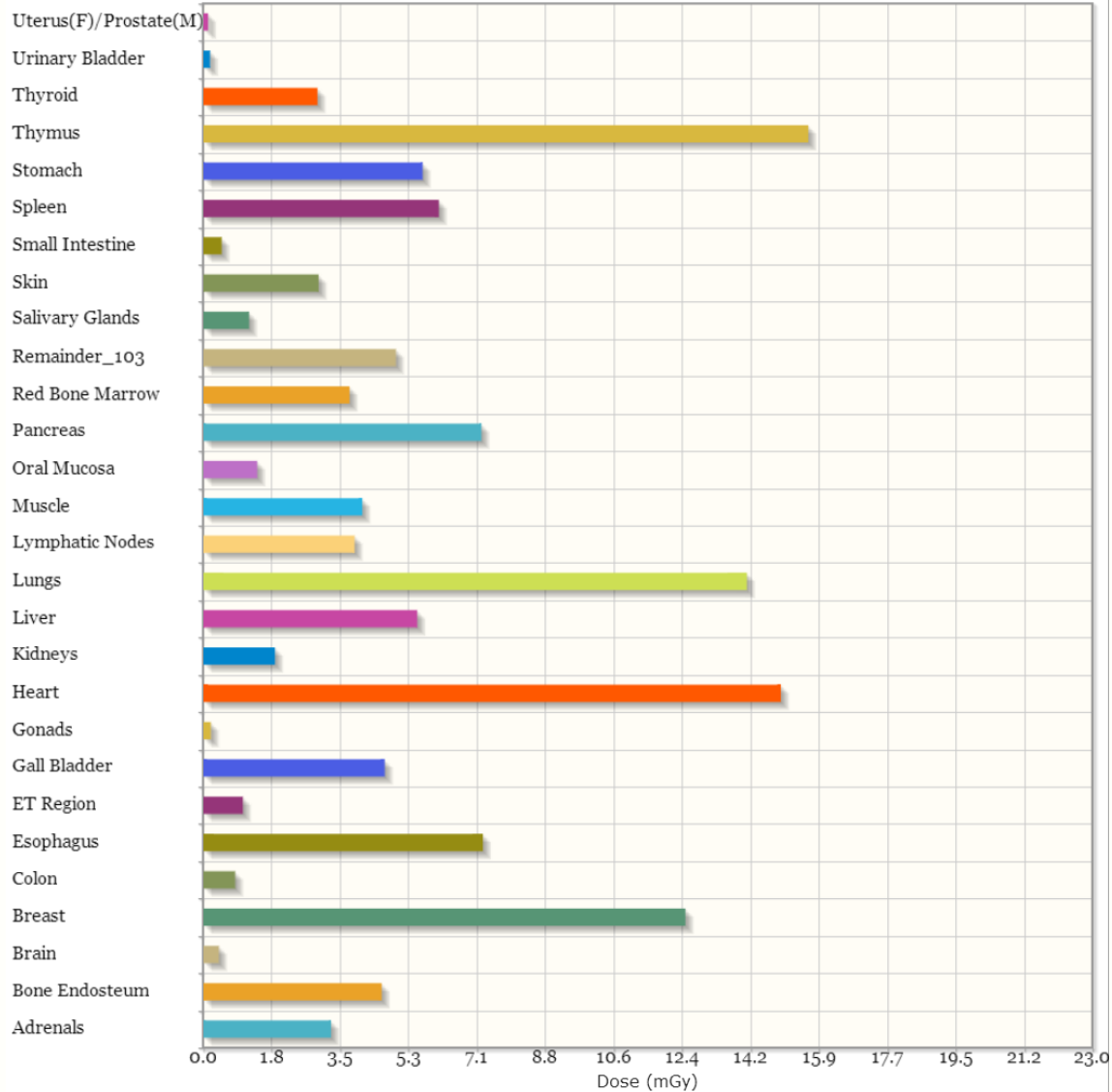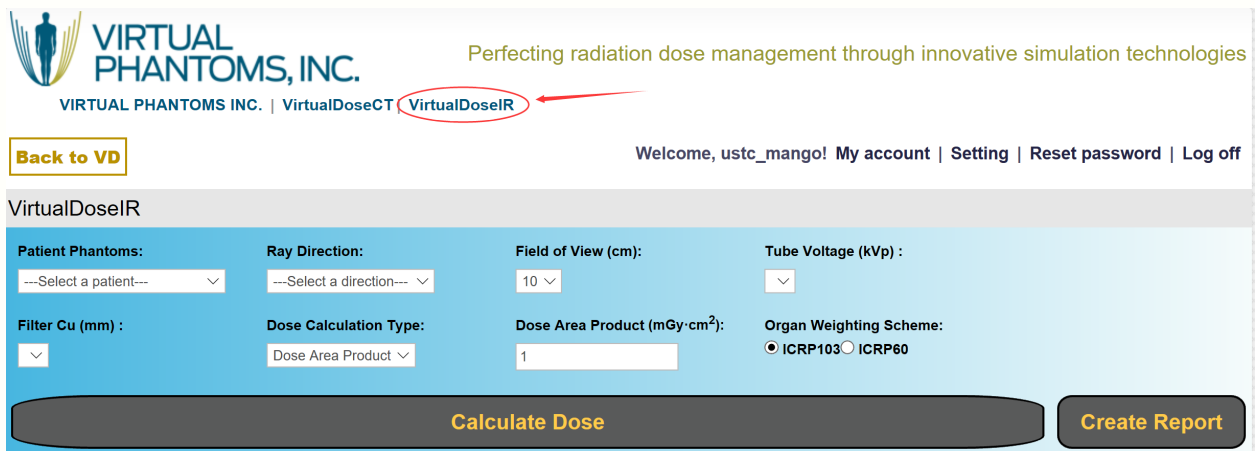
Organ Dose	
Organ/Tissue Name	**Doses (mGy)**
Bone Endosteum	4.61
Brain	0.40
Breast	12.47
Colon	0.82
Esophagus	7.23
Gonads	0.19
Liver	5.53
Lungs	14.06
Red Bone Marrow	3.78
Remainder_103	4.98
Salivary Glands	1.18
Skin	2.98
Stomach	5.67
Thyroid	2.95
Urinary Bladder	0.17
Total Effective Dose(ICRP103) (mSv): 5.86	

Remainder Organs	
Remainder Organs	**Doses (mGy)**
Adrenals	3.30
ET Region	1.02
Gall Bladder	4.69
Heart	14.94
Kidneys	1.85
Lymphatic Nodes	3.91
Muscle	4.11
Oral Mucosa	1.39
Pancreas	7.19
Small Intestine	0.47
Spleen	6.09
Thymus	15.65
Uterus(F)/Prostate(M)	0.12

Figure 5. Plotted and tabulated dose results after use click the "Calculate Dose" button

Perfecting radiation dose management through innovative simulation technologies.

4. VirtualDoseIR Software Tool

Figure 6 VirtualDose-IR^{TM} Software Tool User Interface

4.1 VirtualDose-IR^{TM} Software Tool User Interface

(1) Virtual Patients List

(2) Ray direction List

(3) Field of View List

(4) Tube Voltage List

(5) Filter Cu List

(6) Dose Calculation List

(7) Organ Weighting Scheme

Virtual patient

A user may select a "virtual patient" first from the "—Patient Phantom--" dropdown list, as shown in Figure 7. VirtualDose has in total 25 virtual patients: 50th percentile of adults named RPI-Adult-Male(RPI-AM) and RPI-Adult-Female (RPIAF), pediatric patients of both male and female at different ages (new-born, 1-, 5-, 10-, and 15-year-old), pregnant females at three gestational stages (3-,6-,

and 9month), and a set of obese male and female patients (normal-weight, over-weight, obese level-I, obese level-II, and morbidly-obese). The user can select the one that is closest to the studied clinical case for accurate patient dose calculation. A 2.15 mm Al equivalent thickness operating bed has already been taken into consideration.
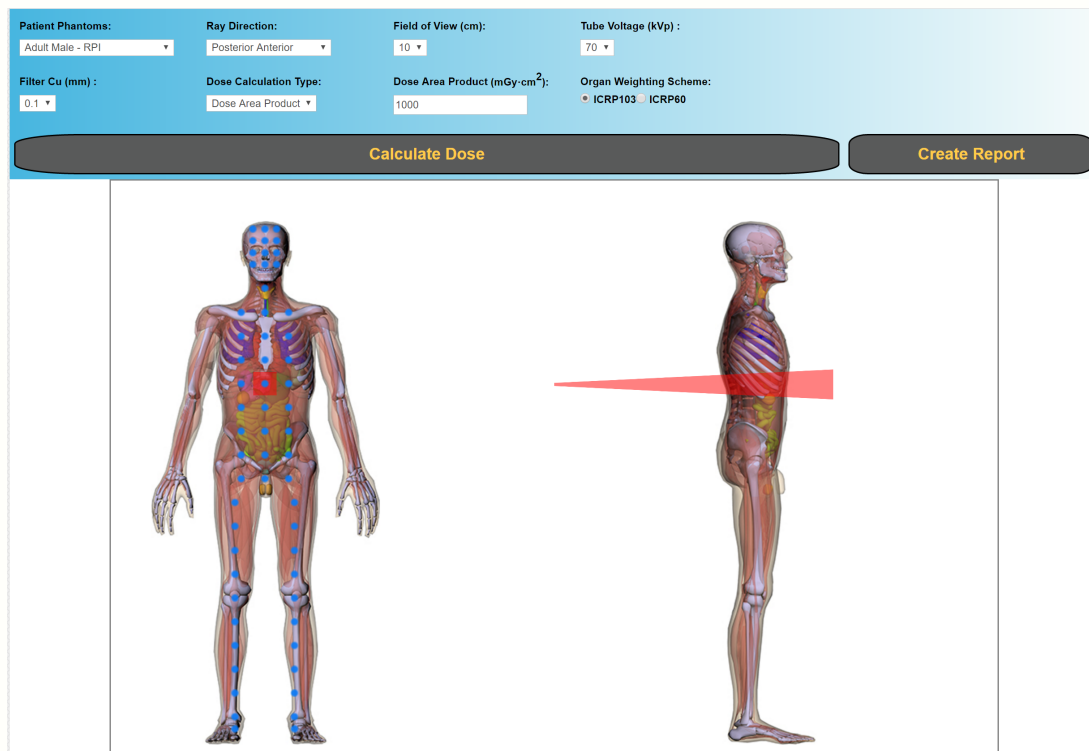
Figure 7 "Virtual Patient" shown within the browser

Ray direction

The next step is to choose a ray direction for the selected "Virtual Patient". Users can only select the directions provided in the dropdown list and the corresponding X-ray projection will then show on the "Virtual Patient" in red color as shown on Figure 7.   Virtual dose provided 6 pre-defined directions including

posterior anterior, left lateral, right lateral, cranial, left anterior oblique and right anterior oblique for users to choose. If the direction is left lateral or right lateral, the X-ray projection will show on the left picture and users can choose irradiation region on the right picture as shown on the Figure 8. If the direction is posterior anterior, cranial, left anterior oblique or right anterior oblique, the X-ray projection will show on the right picture and users can choose irradiation region on the left picture as shown on Figure 7. As irradiation region changed, the X-ray beam in red color will also change to the corresponding region.
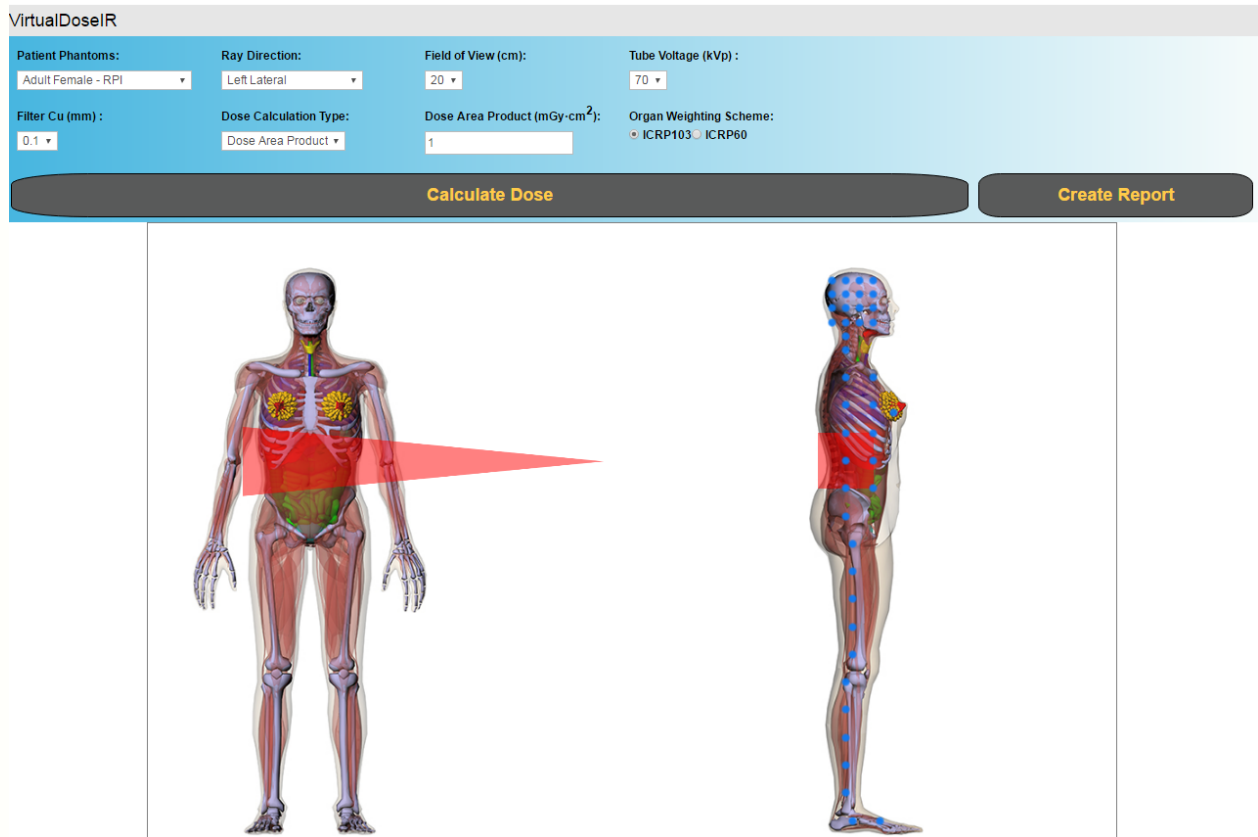

Figure 8 "Ray direction" shown within the browser

Field of View

After choosing the ray direction and irradiation region, users need to select the field of view. There are 4 available sizes of field of views, 10, 20, 30 and 40, each type of field of view means the length of square irradiation field is 10cm, 20cm, 30cm and 40cm. The red region of field of view will update automatically with the chosen field of view.

Tube Voltage & Filter Cu

Tube Voltage and filter Cu can be selected from the dropdown list after the patient phantom, ray direction and irradiation region are chosen, the Tube Voltage and filter Cu dropdown list will update automatically with the chosen patient phantom , ray direction and irradiation region. Users should note that there is a 3.5mm Al filter that an inherent filter applied to all X-ray tubes and unchangeable by user. The Cu filter will be used to filter X-ray with Al filter together.

Dose Calculation Type

There are two kinds of dose calibration methods that users can choose in the dropdown list to convert Monte Carlo results to doses in unit of mGy or mSv. One is using dose area product, the other one is using air kerma rate. If users choose dose-area –product method, users need to input DAP (dose area product) of one treatment in the dose area product text box. If the users choose air-kerma-rate method, the users need to input air kerma rate and treatment time in the air kerma rate text box and total time text box respectively. The air kerma rate need to be measured at the center of field with an ionization chamber. The ionization chamber need to be placed above the source with a constant 44 cm distance.

Tissue weighting factors

Two set of tissue weighting factors (ICRP103 and ICRP60) are provided, the user can choose one of them to calculate effective dose.

4.2   How to use VirtualDose-IR^{TM} Software

(1) Users may select Patient Phantoms list and Ray Direction list at first, then choose the irradiated body part. There are several blue circular points on the phantom pictures, on which users can click in order to choose the irradiated body part. The irradiated region is colored in red. Only after choosing the irradiated body part may users select Tube Voltage and Filter Cu. Users can select Field of View at any time. Users can choose one of the dose calculation types: Dose Area Product (DAP) and Air Kerma Rate.

When all of the parameters are set, users can click "Calculate Dose" button and the results will be immediately plotted and tabulated in the third tab of the main user interface, as shown in Figure 9. Optionally, users can click "Create Report" button to download dose report in Excel file format.

Organs Dose
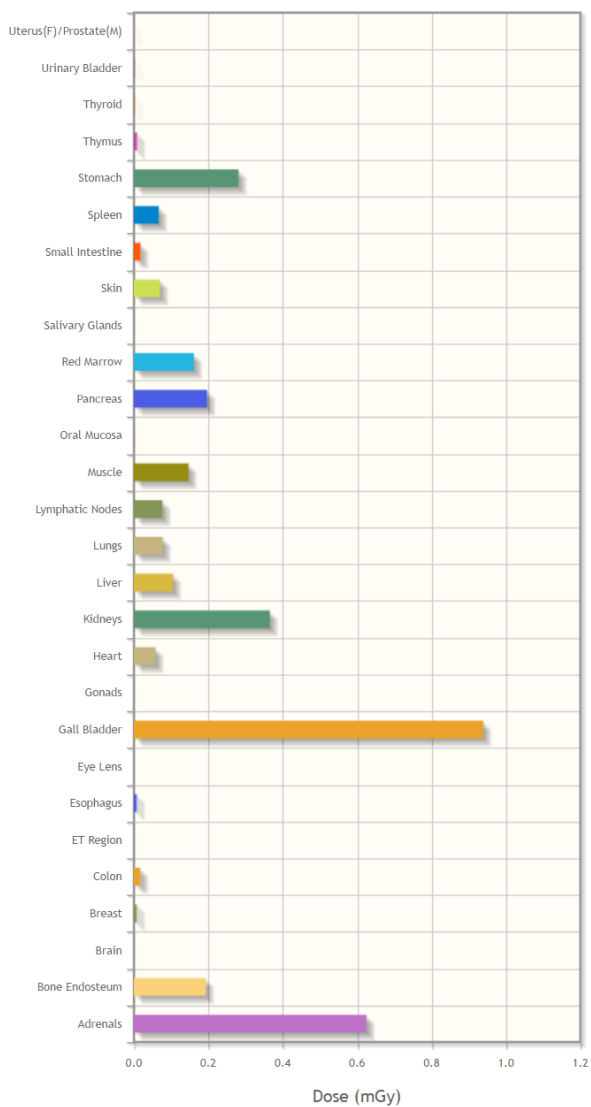
Organ Dose	
Organ/Tissue Name	Doses (mGy)
Bone Endosteum	0.2
Brain	0.0
Breast	0.0
Colon	0.0
Esophagus	0.0
Eye Lens	0.0
Gonads	0.0
Liver	0.1
Lungs	0.1
Red Marrow	0.2
Salivary Glands	0.0
Skin	0.1
Stomach	0.3
Thyroid	0.0
Urinary Bladder	0.0
Peak Skin Dose	70.1
Total Effective Dose(ICRP103) (mSv): 0.1	
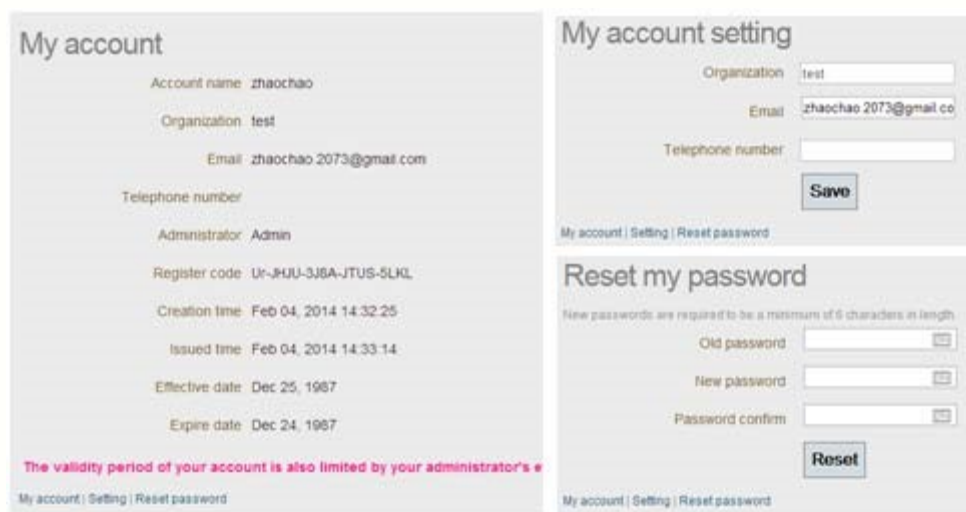
Remainder Organs	
Remainder Organs	Doses (mGy)
Adrenals	0.6
ET Region	0.0
Gall Bladder	0.9
Heart	0.1
Kidneys	0.4
Lymphatic Nodes	0.1
Muscle	0.1
Oral Mucosa	0.0
Pancreas	0.2
Small Intestine	0.0
Spleen	0.1
Thymus	0.0
Uterus(F)/Prostate(M)	0.0

Figure 9 Plotted and tabulated dose results after use click the "Calculate Dose" button

5. User account management

The **User account** will have authority to:

- access the calculation function in our website; (Limited by Effective date and Expire date)
- view its most attributes except Password; (Using the "My account" link in the top right corner of the website)
- edit its Organization, Email and Telephone; (Using the "Setting" link in the top right corner of the website)
- reset its Password with the origin password; (Using the "Reset password" link in the top right corner of the website)

Figure 10. Screen capture of **User** account self-management