The Information System on Occupational Exposure in Medicine, Industry and Research (ISEMIR)

INTERVENTIONAL CARDIOLOGY

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ISEMIR is Information System on Occupational Exposure in Medicine, Industry and Research.

ISEMIR-IC is a tool for radiation protection optimization in interventional cardiology (IC) facilities. ISEMIR-IC is developed as a web- based tool for data collection and analysis of occupational doses for individuals in IC, and for the use of this information to improve occupational radiation protection.

It assists IC facilities in benchmarking their arrangements in radiation protection and safety, and hence in promoting of, implementation of optimization of occupational radiation protection.

Why is ISEMIR-IC focused on interventional cardiology?

In the last three decades, the use of image guided interventional procedures in cardiology has increased significantly, bringing great benefit to millions of patients around the world. As technology improves, the medical capabilities of these procedures continue to expand, adding further to the armamentarium for diagnosis and treatment of patients with cardiac problems.

All of these procedures require health professionals (including interventional cardiologists, electrophysiologists, nurses and medical radiation technologists) to be present in the room alongside the patient when radiation is being used. This may result in occupational exposure.

While it has been long known that there is a significant potential for health professionals present during interventional cardiology procedures to receive occupational exposure, reported details have been typically limited to specific interventional cardiology facilities and situations. A more global perspective has been lacking, as well as the availability of systematic means for improving occupational radiation protection in interventional cardiology facilities throughout the world.

What are the objectives of ISEMIR-IC?

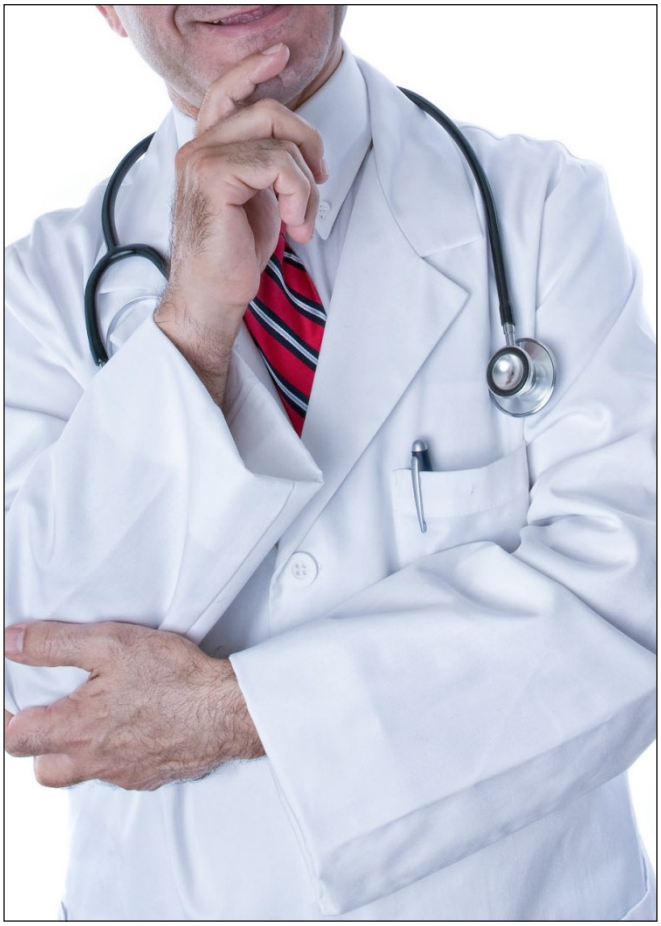
- to facilitate the implementation of ALARA practices and effective exposure management
- to provide efficient collection, maintenance of data on occupational exposure and radiation practices
- to allow IC facilities to benchmark their own facility and individual radiographers' performances against global data
- to define follow-up actions to address identified gaps and disseminate lessons learnt

How was ISEMIR-IC developed?

The ISEMIR project was initiated by the IAEA in January 2009 to focus on very specific topical areas where occupational radiation protection for the workers faces unresolved issues and gaps.

The ISEMIR is coordinated by the IAEA. In the design phase, the IAEA was assisted by an Advisory Group with representatives from international organisations as well as from the five main world regions. The Advisory Group identified two specific areas in radiation use, where non-trivial occupational exposures occur, interventional cardiology and industrial radiography.

For each of these 2 topical areas a working group was set up with experts covering the respective area in a comprehensive way with respect to professions, type of radiation usages, geographical regions and other factors.



What was the role of the ISEMIR Working Group on Interventional Cardiology?

ISEMIR Working Group on Interventional Cardiology's (WGIC) main task was to draw an overview picture of the situation concerning occupational exposures and radiation protection of staff in IC worldwide. They had to to identify both good practices and shortcomings, and to define actions to be implemented for assisting each of the regulatory bodies, medical physicists, medical staff, technicians and nurses, dosimetry service providers and X ray machine suppliers, in improving occupational radiation protection.

As part of its actions, WGIC performed a worldwide survey of occupational radiation protection in IC. Responses were received from 45 chief interventional cardiologists of IC facilities, 201 responses from individual interventional cardiologists, and from 81 regulatory bodies. The data collected were able to demonstrate:

- a clear need for worldwide improved optimization of occupational radiation protection in IC
- an ability to compare doses for specific occupational roles and conditions, and to assess the impact of radiation protection actions, and to follow dose trends.

Read more about the survey in IAEA TECDOC 1735.

As a result, WGIC has proposed to the Advisory Group and the IAEA to create an international database for the end-users as a tool for optimization of occupational radiation protection.

Benefits of participation in ISEMIR-IC

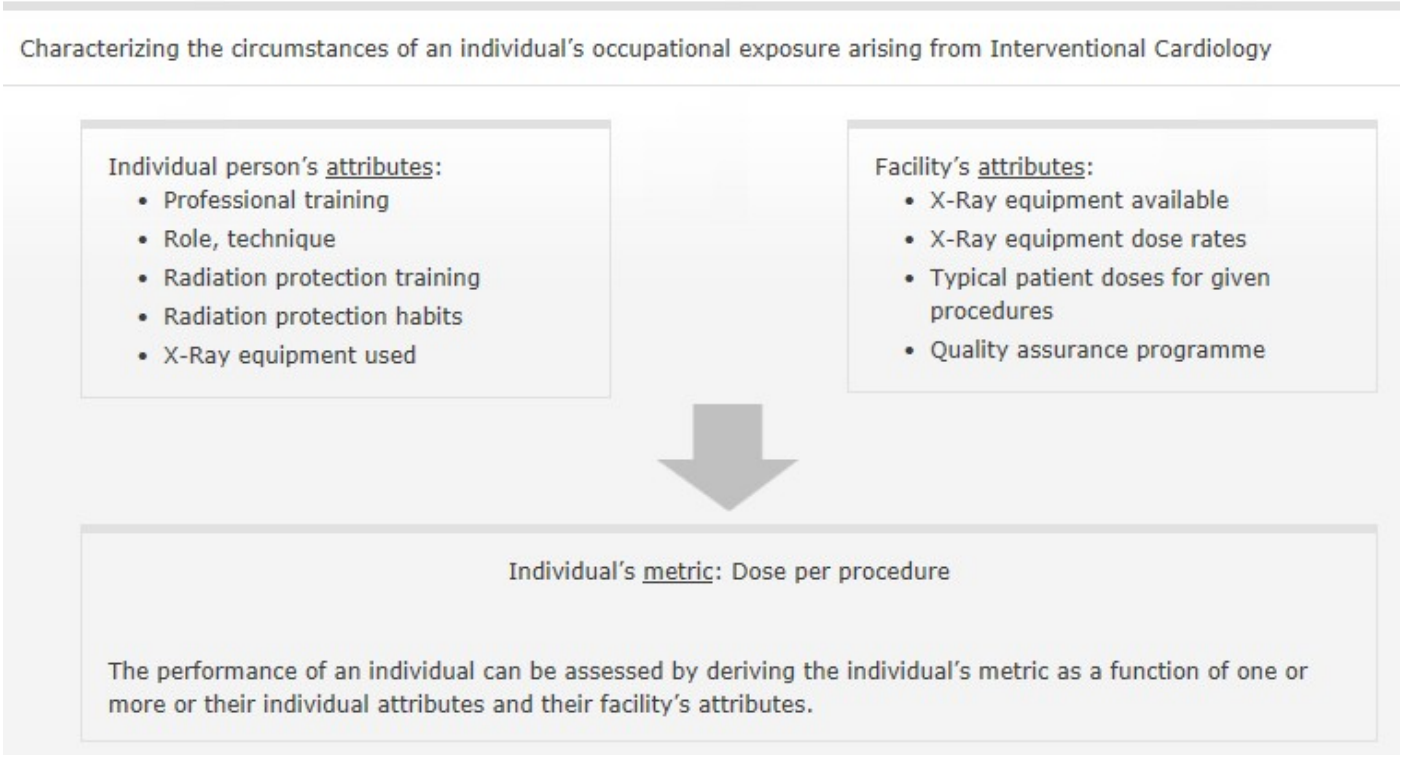
The participation is free of charge and many parts of the data entry are voluntary in order to make it accessible to all interested parties. Each participating IC facility will be able to provide annual information about the facility, including annual number of procedures performed, number of catheterization laboratories, the X ray equipment used, typical patient doses for given procedures, X ray equipment performance data (dose rates), data on the personal dosimetry provider, and individual personnel working in the facility.

As an outcome of the data entry, an IC facility will be able to review its assessment of the effectiveness of the optimization of radiation protection. The metric is determined by occupational dose per procedure. See the flowchart below:

The international database will support two broad types of analyses:

- occupational doses per procedure as a function of personnel and facility attributes
- benchmarking

A registered IC facility user is able to perform statistical analyses of occupational effective dose per procedure based on combinations (one or more) of the individuals' personal attributes and facility attributes. IC facilities are able to benchmark their own facility and individual personnel performances against global data and identify areas for improvement and corrective actions that should lead to an improvement in radiation protection.



How to register for participating in ISEMIR-IC

The ISEMIR-IC database is based around individual IC facilities. Each IC facility needs to select a point of contact – the Facility Coordinator (FC). This person is responsible for entering the facility's data. FC has to follow the steps below in order to gain access to ISEMIR-IC:

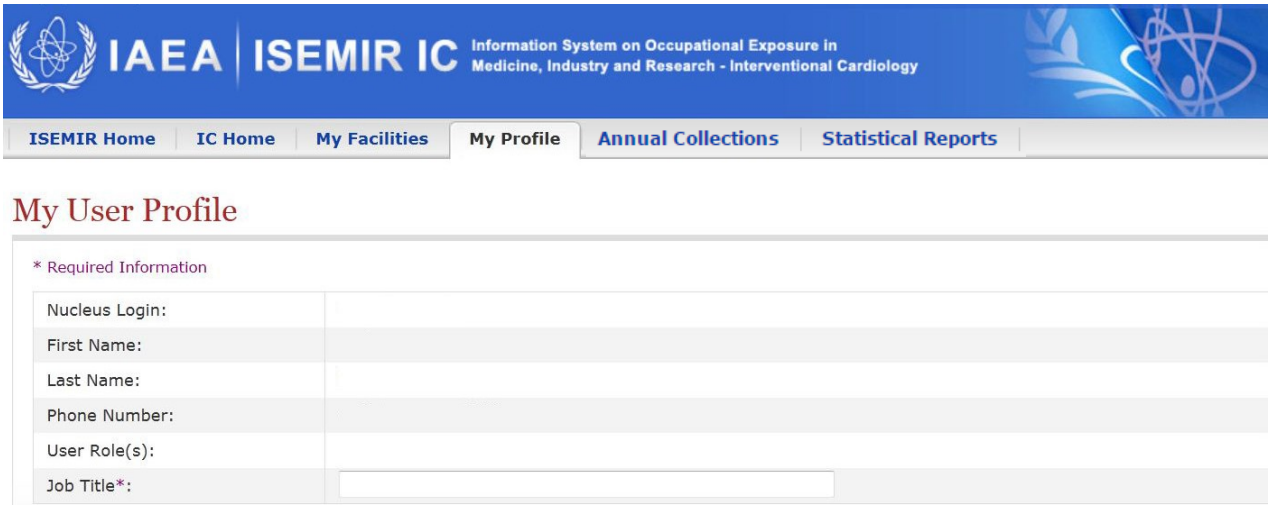
1. FC should first register with NUCLEUS, a common access point to about 130 IAEA's scientific, technical and regulatory information resources http://nucleus.iaea.org/*
2. He/she needs to confirm the email link received upon registration
3. Once his/her IAEA NUCLEUS account is activated, the FC should return to ISEMIR https://nucleus.iaea. org/isemir/

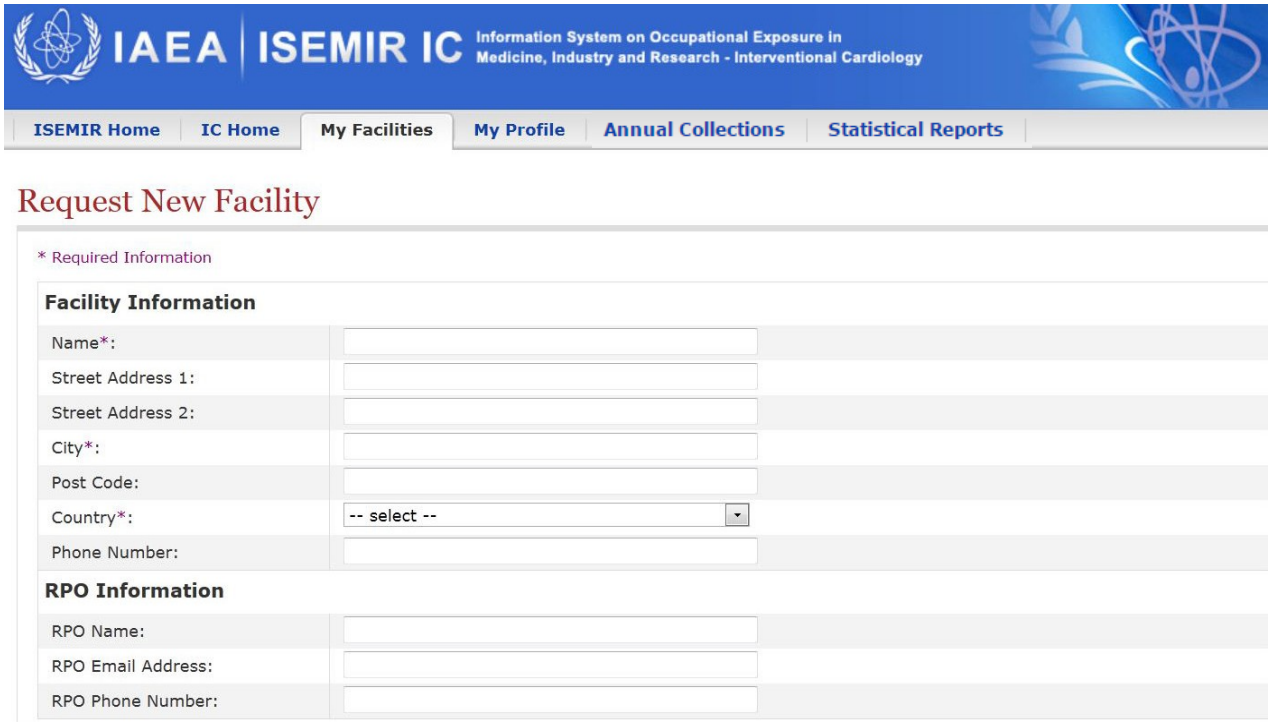
4. In order to participate in ISEMIR-IC, the FC should click on ISEMIR-IC

*If the FC is already registered with Nucleus, he/she can simply sign in using the existing user name and password.

On the home page of ISEMIR-IC, you need to click on the button "Request Access" to gain entry to the database.

Fields such as Nucleus Login, First Name, Last Name, and Phone Number, are automatically filled in from information in NUCLEUS. The "Request Access to ISEMIR" page requires some additional information and the IC facility information. Mandatory fields are indicated with an asterisk. In the "Job Title" field please enter your professional role – e.g. radiation protection officer (RPO), medical physicist, etc. The options for the "ISEMIR User Role" are limited to "Facility Coordinator".





Please be accurate in entering your IC facility's name, city, and country as the ISEMIR-Administrator needs to be able to verify that it is a genuine request and to make sure that there is no confusion between IC facilities with similar names.

Note that the optional "RPO Information" is a means for establishing contact with the radiation protection officer (RPO) or radiation safety officer (RSO) for the IC facility if the FC is not in that role.

Once the request for access has been submitted, the ISEMIR-Administrator will be notified. After the request has been reviewed and approved, the FC will receive an email confirming the approval and that the FC will now have access and be able to commence data entry for that IC facility.

Note that a person can be a FC for more than one IC facility. Once in the ISEMIR-IC database, a registered FC can click on the "My Facilities" tab, and then click on the "Request New Facility" button. This brings up a page requesting information for the new IC facility. Once the new IC facility is approved, the FC is notified accordingly and the FC will now be able to commence data entry for the new IC facility.

How to enter data

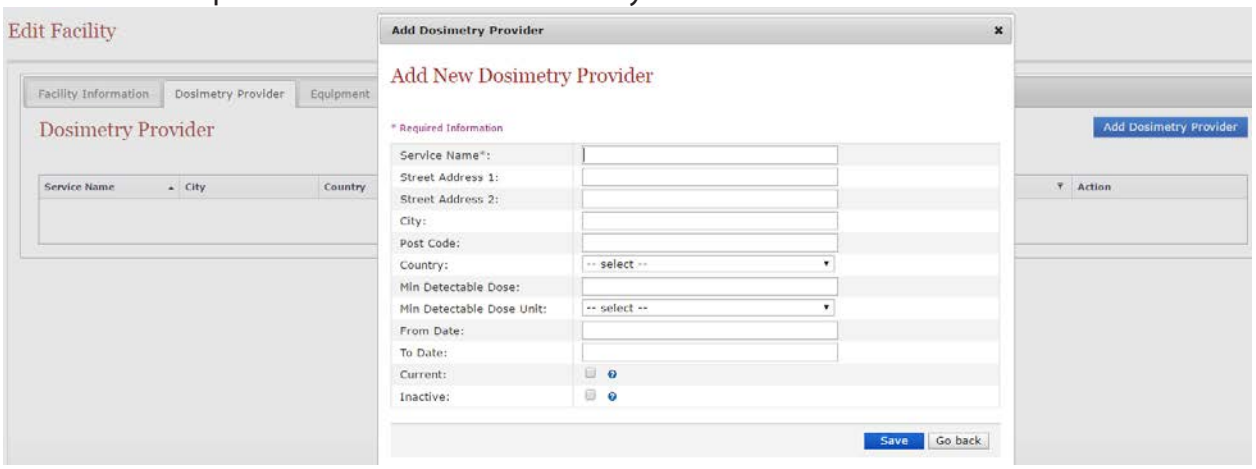
After the registration, you can see 3 available tabs:

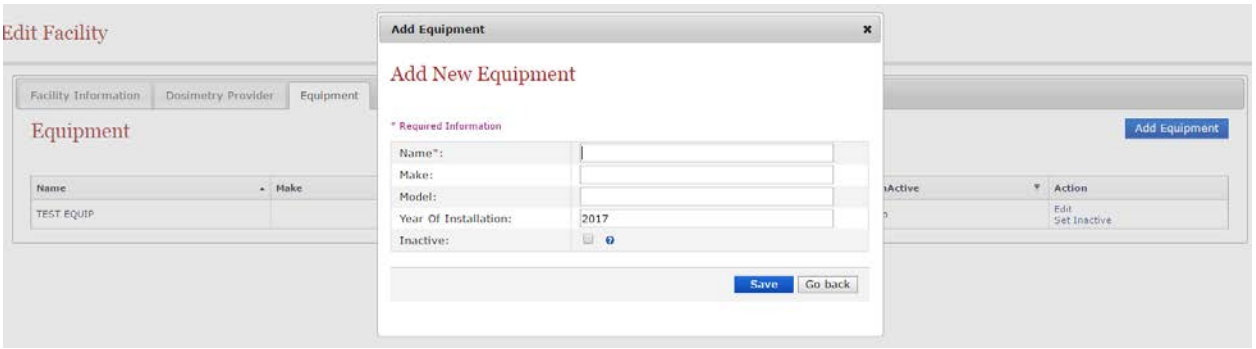
1. **My Facilities**
2. **My Profile**
3. **Annual Collections**
    a. The FC will enter the data in the tab Annual Collections.

1. My Facilities

This tab displays the IC facilities for which you are the FC. The only action available on this page is to edit any of your IC facilities – name, address and contact details. Any saved changes will result in a notification being sent to the FC, as a record of the change.

In addition, you can optionally add information about your dosimetry provider or register information about your IC imaging equipment in this section. The current version of ISEMIR-IC records this information for possible use in future IAEA analyses.





2. My Profile

This tab displays your User Profile. The only action available on this page is to edit your job title.

3. Annual Collections

Data for each IC facility is entered per calendar year. The data is grouped into “annual collections“. The data in each annual collection may be entered progressively, at various times during the year until the completion, or it may be entered at once.

The data for a given IC facility can be in 1 of 3 possible states:

- *In progress*: The FC can view, edit and add data for the IC facility.
- *Submitted*: The FC has completed the data entry for the given year, and "submits" the data to the ISEMIR-Administrator. Once submitted, the FC coordinator cannot edit that year's data.
- *Published*: The ISEMIR-Administrator has checked the submitted data for any anomalies. The data is ready to be "published". Once published, the data is available in the ISEMIR-IC database for inclusion in any statistical analyses or benchmarking exercises. If there are queries regarding the submitted data, the ISEMIR-Administrator will change the data status back to "In progress", and the FC will be asked to address the issues and then re-submit.

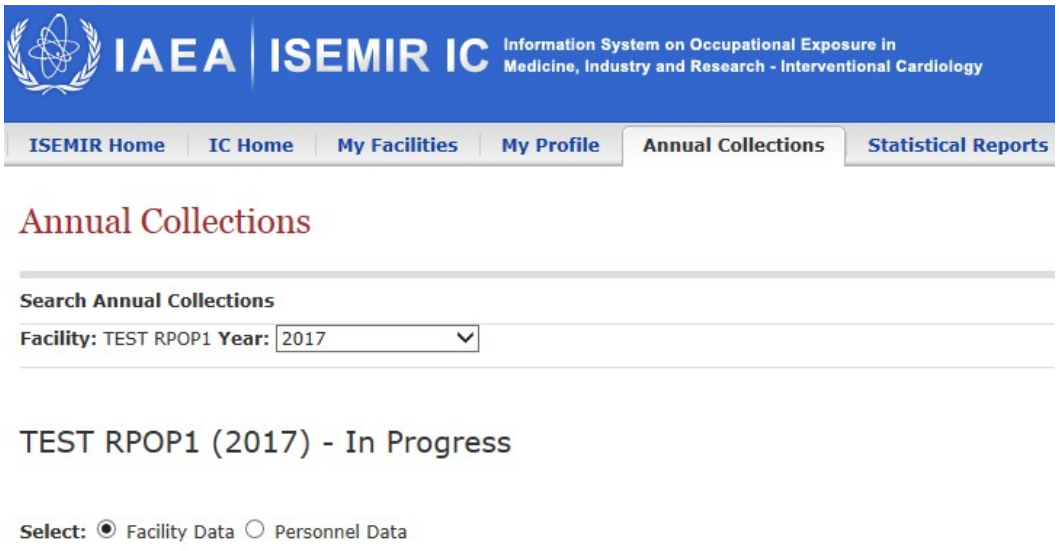
Please note that an annual collection will stay in the status *In Progress* until the FC completes the annual data entry and submits the data for publication. In addition, the statistical and benchmarking capabilities are available only for the annual collections in the status "Published".

The FC can view their own IC facility data at all times, regardless of the status of a given year's data.
A given IC facility's data can be viewed only by that facility's FC.

In order to enter the data, the FC first needs to select the particular year and facility.

On the first page under the Annual Collections tab, the FC can choose the IC facility and the calendar year to be viewed or edited. If there are no current data for a given IC facility and year, an information box informs the FC as such, and a button labelled Start Data Collection can be used to initiate data entry for that facility and year. The annual collection is automatically in status “In Progress”.

Each annual collection includes 2 datasets to be completed by the FC – 1 related to facility information and 1 related to occupationally exposed personnel.

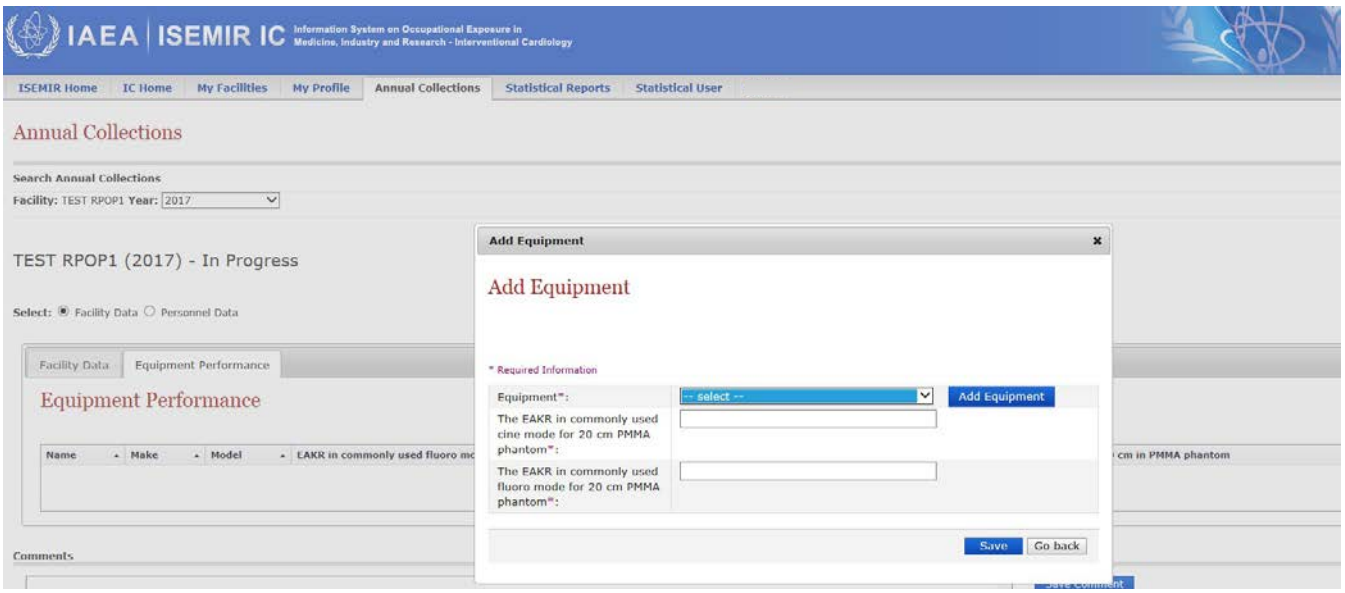


The **facility-related information** contains 2 parts:

a. Facility Data
b. Equipment Performance

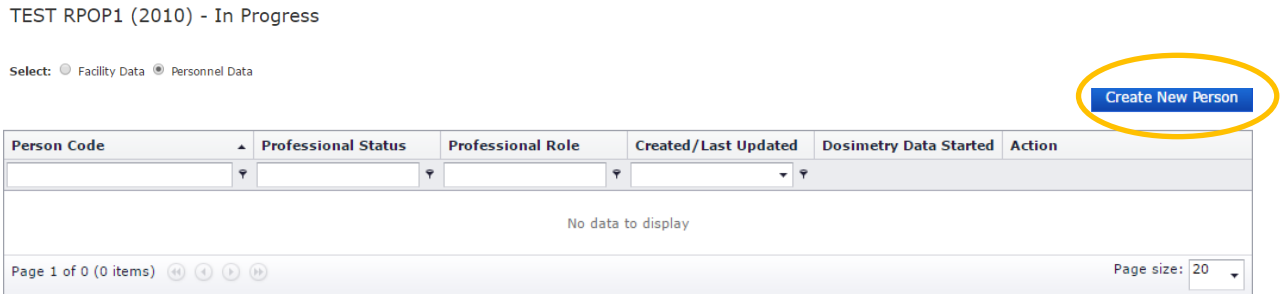
a. The part on Facility Data includes mandatory questions about number of IC and electrophysiology (EP) procedures and number of catherization laboratories. The final question asks if the registration of the IC equipment performance is monitored under a quality assurance (QA) programme.

b. The section on Equipment is voluntary and serves for FC to keep track of the equipment use. The FC can register new equipment in the Facility part of the information. After registration of new equipment, he/she can track its performance from year to year. In addition, the current version of ISEMIR-IC records this information for possible use in future IAEA analyses.



The **individual-related information** contains four parts:
a. Person-related Information
b. Radiation Protection Information
c. Workload Information
d. Dosimetry Information

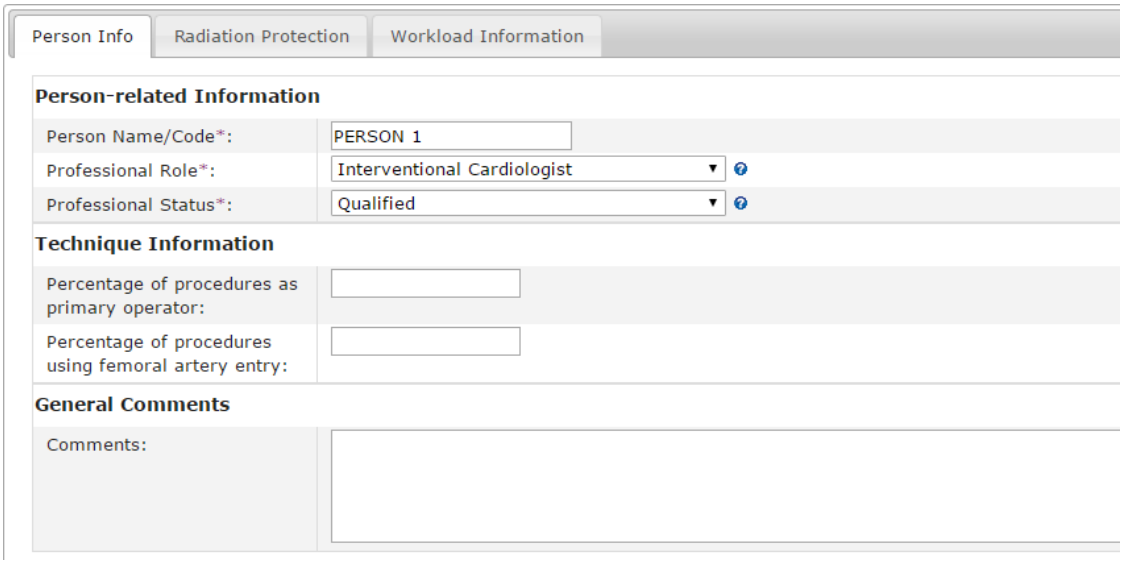
To add an individual, the FC first selects "Create New Person." A screen will appear with three tabs for Person Information, Radiation Protection and Workload Information.



a. In the section Person Information, the FC inputs the person's code, professional role and status indicating the person's level of experience. A simple code or initials may be sufficient and ensures total anonymity. Note that ISEMIR-IC does not track individuals over years, but the FC may choose to use the same code for an individual over successive calendar years.

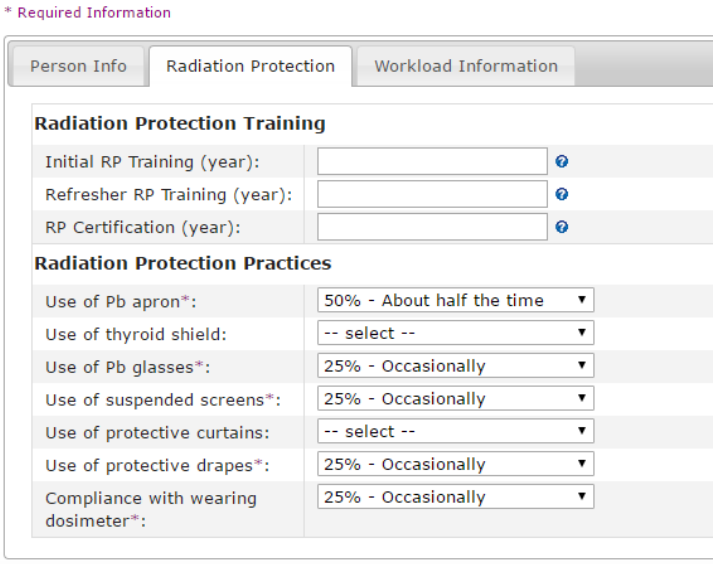
The options for the professional roles are interventional cardiologist, electrophysiologist, medical radiation technologist, nurse, other doctor and other health professional. There are 2 additional fields on Technique Information that may be applicable for interventional cardiologists, electrophysiologists or other doctors. Note that the term medical radiation technologist is used to cover a number of terms that are used throughout the world such as radiographer and radiologic technologist.

The purpose of the fields *Percentage of procedures as primary operator* and *Percentage of procedures using femoral artery entry* is to characterize where the specialist is positioned with respect to the patient (the source of scatter).

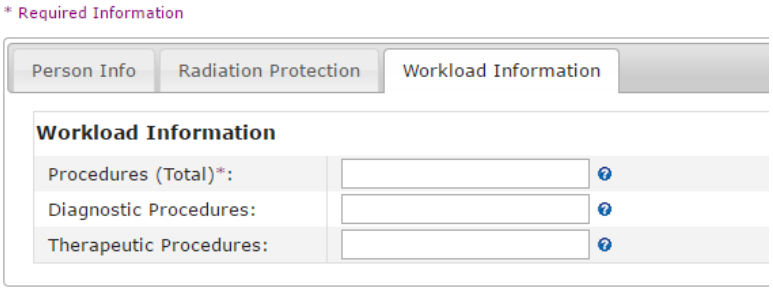


b. The section Radiation Protection captures the person's radiation protection training information and radiation protection practices.

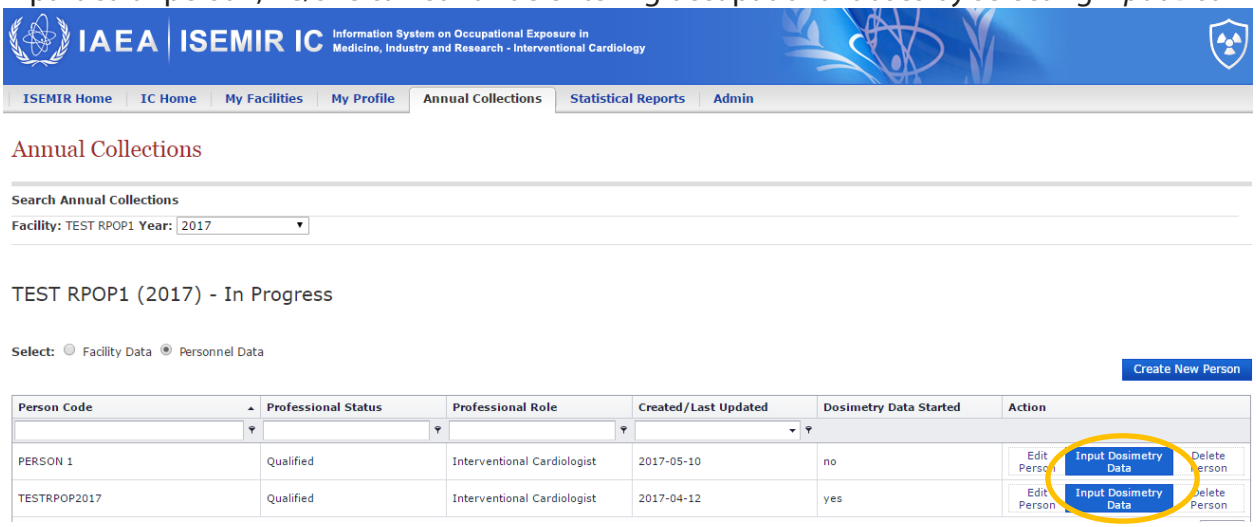
Radiation Protection Practices can be selected from 5 options – 100% (nearly all), 75% (mostly), 50% (about half), 25% (occasionally), and 0% (almost never). The values in these fields characterize the person's habits with respect to occupational radiation protection.



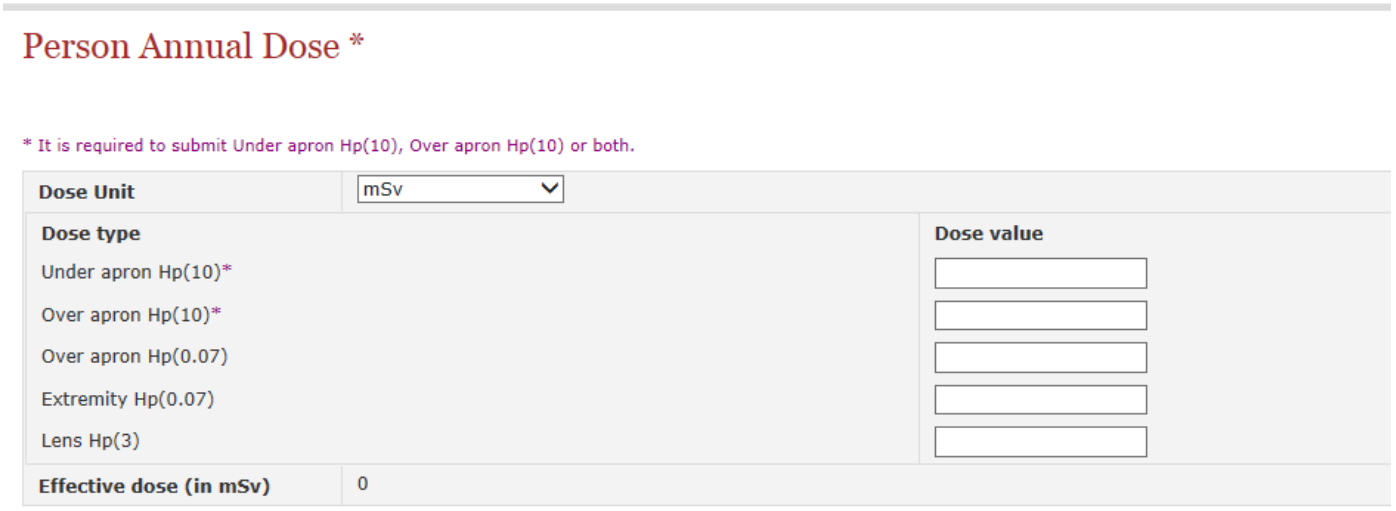
c. In the Workload Information part, the FC should fill in the total number of IC procedures this person performed during the year. It is optional to provide the separate values for diagnostic and therapeutic procedures.



d. Once the FC has entered the person-related, radiation protection and workload information for the particular person, he/she can continue entering occupational doses by selecting *Input Dosimetry Data*.



FC needs to enter mandatory information related to person annual dose. In order to initiate the data entry for the selected person, the FC needs to select the Dose Type from a list of options based on dosimeter wearing position and reported dose quantity: Under apron $H_p(10)$, Over apron $H_p(10)$, Over apron $H_p(0.07)$, Extremity $H_p(0.07)$, and Lens $H_p(3)$.
Entering information about the dose reported for under apron Hp(10), over apron Hp(10) or both is required. This information is used to calculate effective dose, which is displayed at the bottom of the screen. The FC is able to select the dose unit of the measurements. This is automatically converted into mSv.



It is optional for the FC to also enter the dose values for each month, for every 2 months, or for several months. In this case, the term "Monthly" is used figuratively representing the monitoring cycle of the particular IC facility.
In occasions, when a numerical value is not available for a given monitoring period, please use the following codes:

ab: This is used to indicate that a person was not monitored in that monitoring period because they were absent from the IC facility.

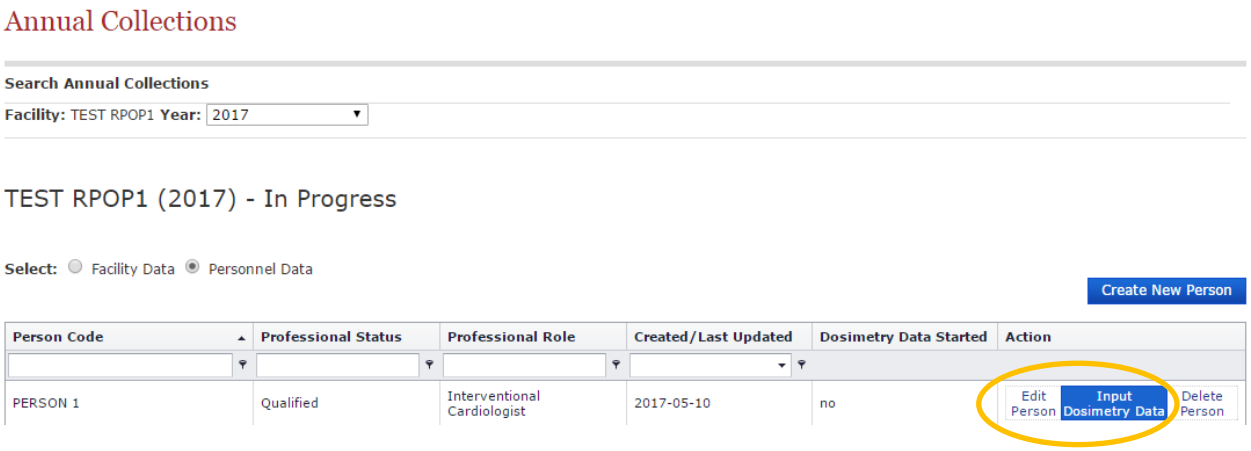
co: This is used to indicate that the dosimeter was carried over to include the next monitoring period

as well. E.g. if the normal monitoring period is Jan – Feb, Mar – April, etc., then if the Jan – Feb dosimeter is carried over to include Mar – April, the table would have a numerical entry for Jan and "co" entered for Mar.

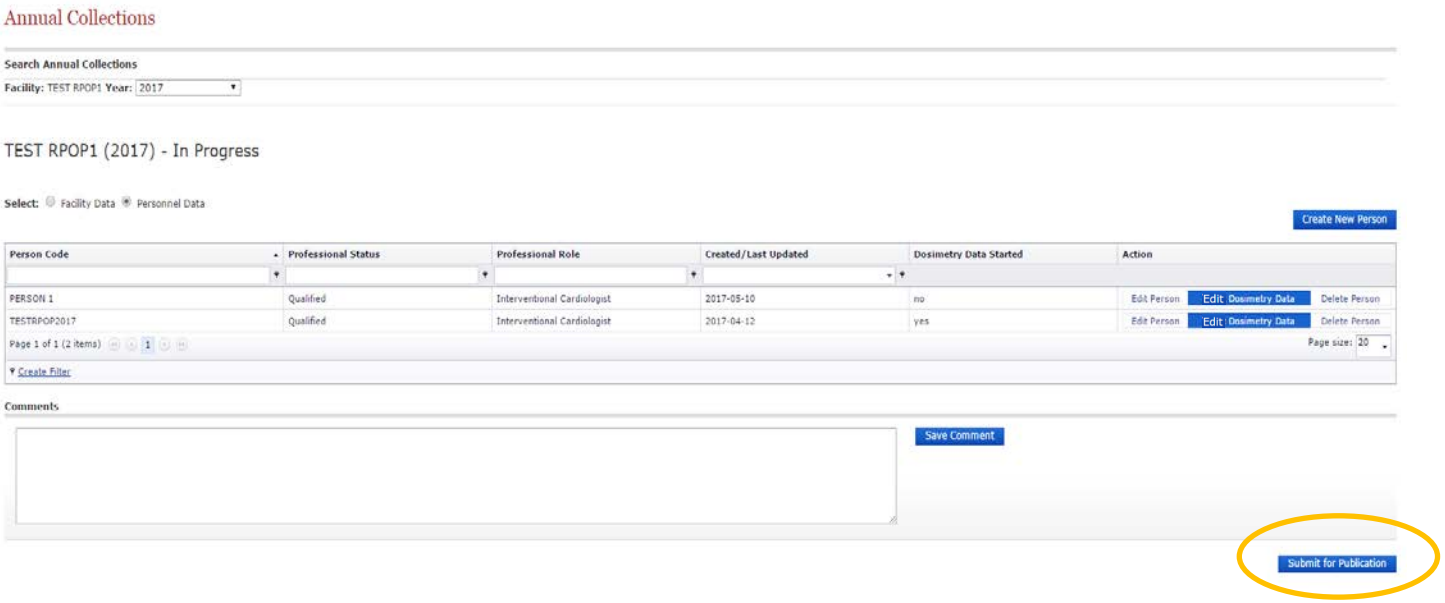
nr: This is used to indicate that there are no reported data when there should be, either because there is no measurement (and the person was not absent) or the data are missing for unknown reasons.

na: This is used to indicate blank periods when no monitoring reports exist for that particular month – i.e. they are part of a longer monitoring cycle.

If the FC wishes to make any changes in the individual-related information, he/she may do this by selecting *Edit Person* or *Edit Dosimetry Data*. The *Edit Person* button is used to make changes in the person-related, radiation protection and workload information and the *Edit Dosimetry Data* button is used for dosimetry changes.



Once the data entry for the facility and all personnel for a given year is completed, the dataset can be submitted. The FC does this by clicking on the "Submit for Publication" button at the lower right of the main Annual Collection screen. When the submitted data has been reviewed and there are no further queries, the data can be published and become part of the ISEMIR-IC database, available for analysis and benchmarking.



Analysis and benchmarking

Statistical reports available in ISEMIR offer the FC further insights into the submitted facility data and can serve as a benchmarking tool. Each person entered in the ISEMIR-IC database is characterized by a dose metric, mean occupational effective dose per procedure, and by the attributes entered in the personnel data section of the annual collection. Data may be filtered on a variety of characteristics of the facility and individual workers. Statistical analysis of the dose metrics for a given group of persons can be used to identify areas that could be improved or, on the other hand, that represent good practice.

ISEMIR-IC provides 2 types of analysis:

1. **Facility-based analysis**
2. **Individual-based analysis**

1. Facility-based analysis

This statistical analysis enables user to filter based on the selected year and compare its facility or a selected group from the facility against the database.

This can be illustrated using the simple example, shown below. In this case, the FC would like to see the statistical analysis and the accompanying graphs for the year 2007. He/she would like to compare the facility data against the whole database. In addition, he/she would like to see this analysis only for the interventional cardiologists who always wore dosimeters.

Mandatory filters

Case	**Case 1**
Year*	2007
Show statistical reports for*	My own facility and Entire database

Advanced filters

Role	Interventional Cardiologist
Professional Status	-- select --
Total procedures/year	equal to
Pb apron used	-- select --
Suspended screen used	-- select --
Pb glasses used	-- select --
Protective drapes used	-- select --
Dosimetry worn?	100% - Almost always

Reset Filters | Apply Filters

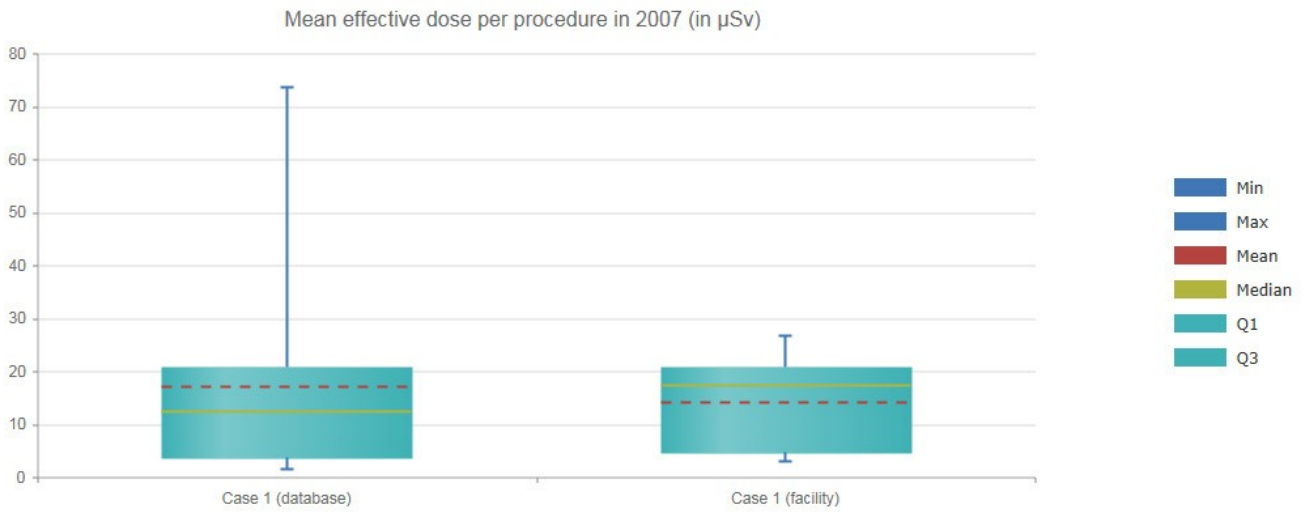
After applying filters, ISEMIR-IC displays the statistical analysis for the facility and for the whole database.

Statistics based on selected filters

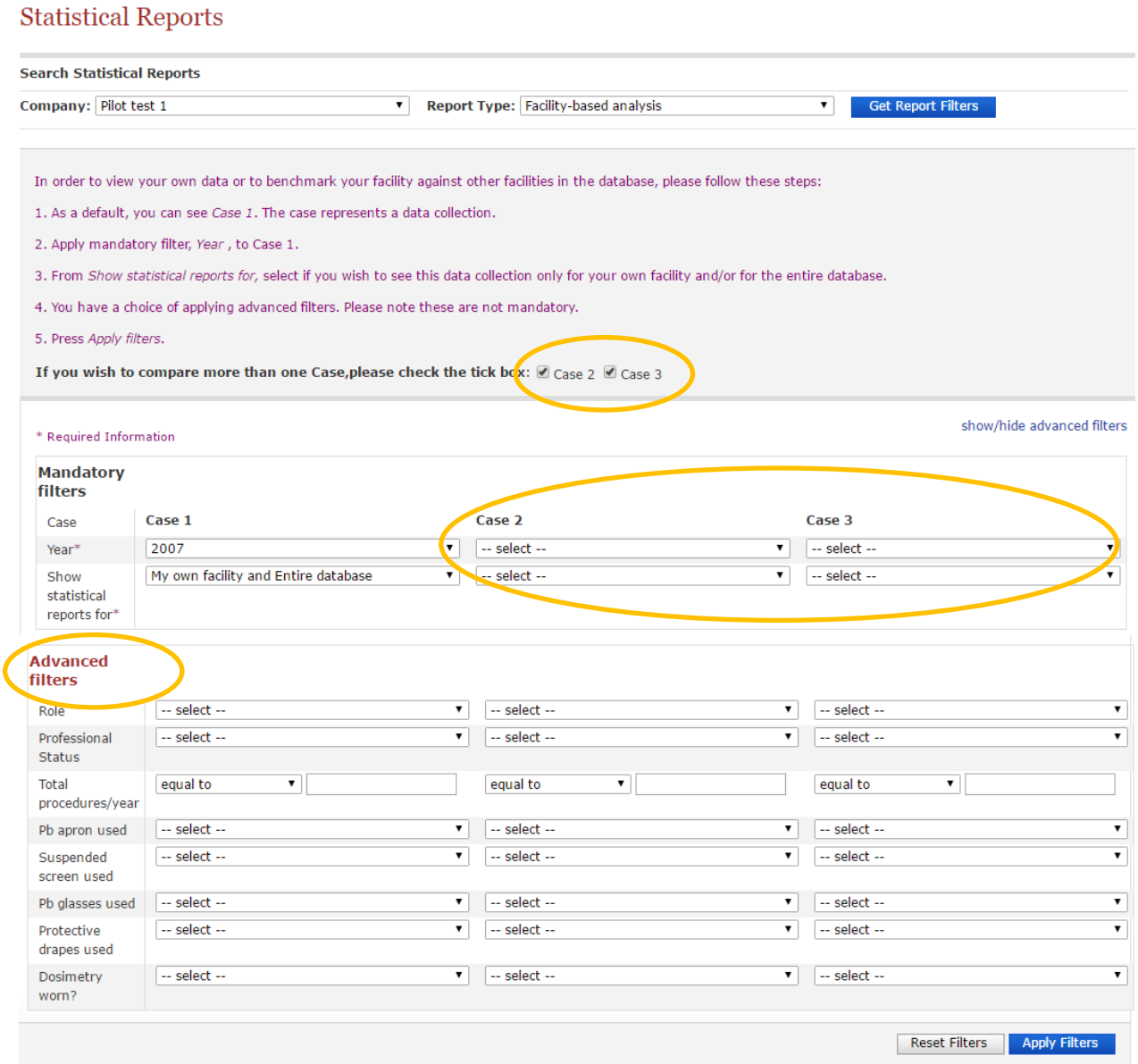
Statistics	Case 1 (database)	Case 1 (facility)
Number of individuals in the case	11	7
Mean effective dose/procedure (in µSv)	17.06	14.01
Standard deviation	20.75	9.71
Min	1.49	2.98
Q1	3.78	4.74
Median	12.28	17.38
Q3	20.75	20.75
Max	73.52	26.74

Based on this analysis, the FC sees that the mean effective dose per procedure for each individual in the facility is lower than the mean effective dose per procedure for each individual in the database average.

ISEMIR-IC also provides the user also with a visual presentation of the results:

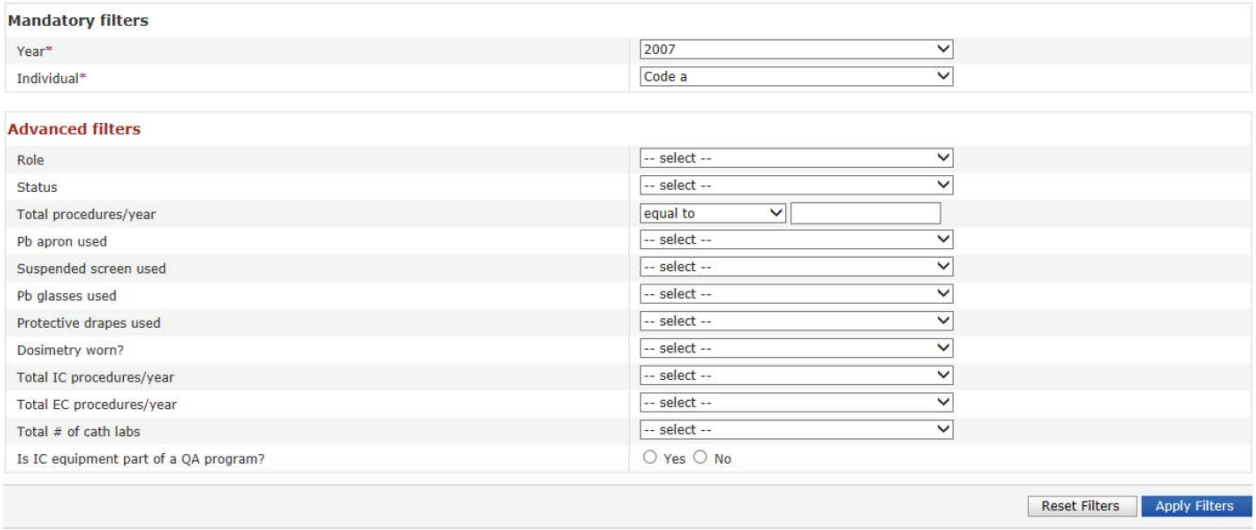


The user can select up to 3 different types of comparisons called “cases“ and display them next to each other. This way more complex scenarios might be compared, such as two groups of electrophysiologists, where one group performs more than 500 procedures per year and the other group performs less than 500 procedures per year.
(For complex scenarios, the user needs to tick Case 2 and/or Case 3. Select the year and the type of the statistical dataset. In addition, the user is able to select additional filters as shown on the screenshot below.)

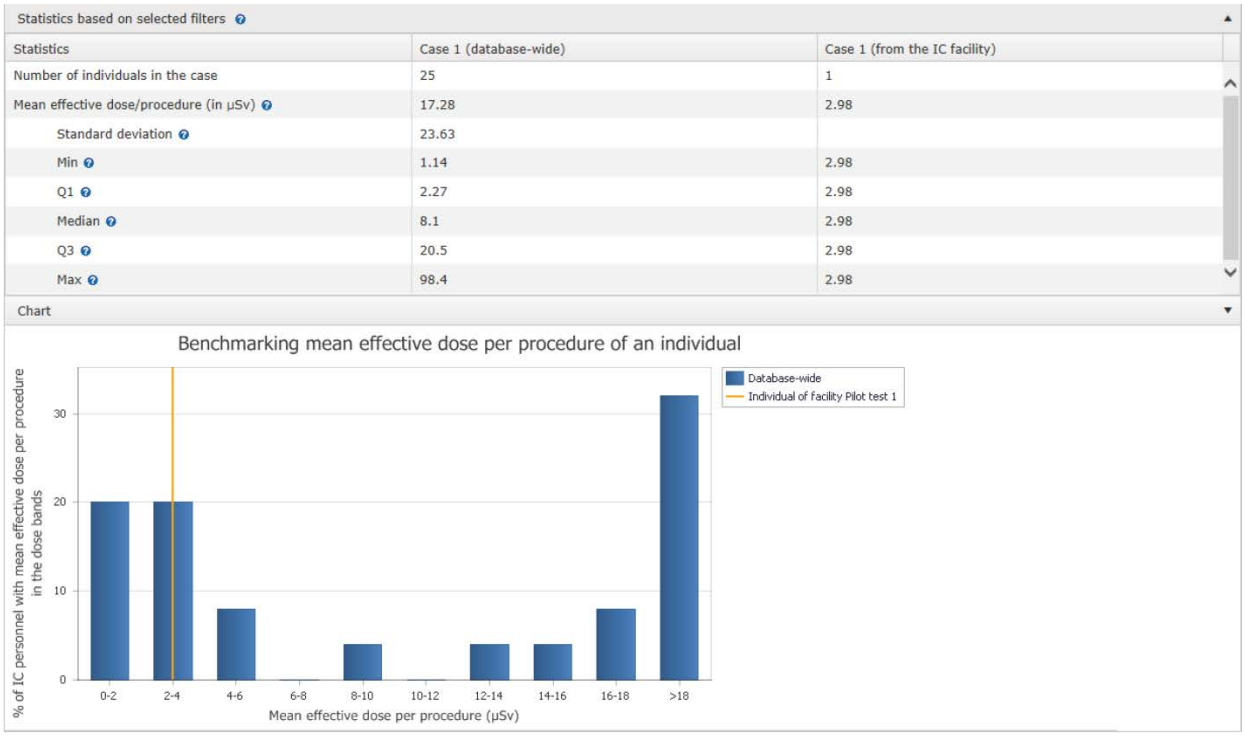


2. Individual-based analysis

The FC can benchmark any individual working in the facility through this type of analysis. The FC needs to select a particular year and an individual for the comparison with the whole database.
In addition, the FC can select supplementary filters such as level of seniority, the use of protective equipment or number of procedures.



As a result, the FC can review the statistics and graphical representation of mean effective dose per procedure for the selected individual and for the population of personnel in the database.
In the graph, the x axis shows the mean effective dose per procedure grouped into dose bands and the y axis shows the percentage of the population in the database in each dose band. The blue vertical bars represent the distribution of results for the population in the database and the yellow vertical line represents the result for the selected individual.
As the example shows, 40 per cent of personnel from the ISEMIR-IC database in 2007 had a dose metric in the same dose band or a lower dose band than the individual marked as "Code a".



Confidentiality

Individuals and facilities are anonymised in the database. IAEA cannot and does not reveal the identity of the relevant facility, and all submitted personal or facility data are considered to be confidential and will not be shared.

The published analysis will be generic and will not refer to a specific facility but will rather be based on a regional division.

Do you have any questions?

You can contact us at ISEMIR-IC.Contact-Point@iaea.org.

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