ICM+ Standard of Procedures

Raumedic Neurosmart monitor

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Prerequisites

1. **A laptop (or a PC) with the latest ICM+** and ICM+ Raumedic interface module installed
2. **Raumedic monitor and Raumedic Neurosmart drivers** installed on ICM+ laptop
3. **Appropriate cables** – USB cable connecting Raumedic MPR monitor with the laptop.

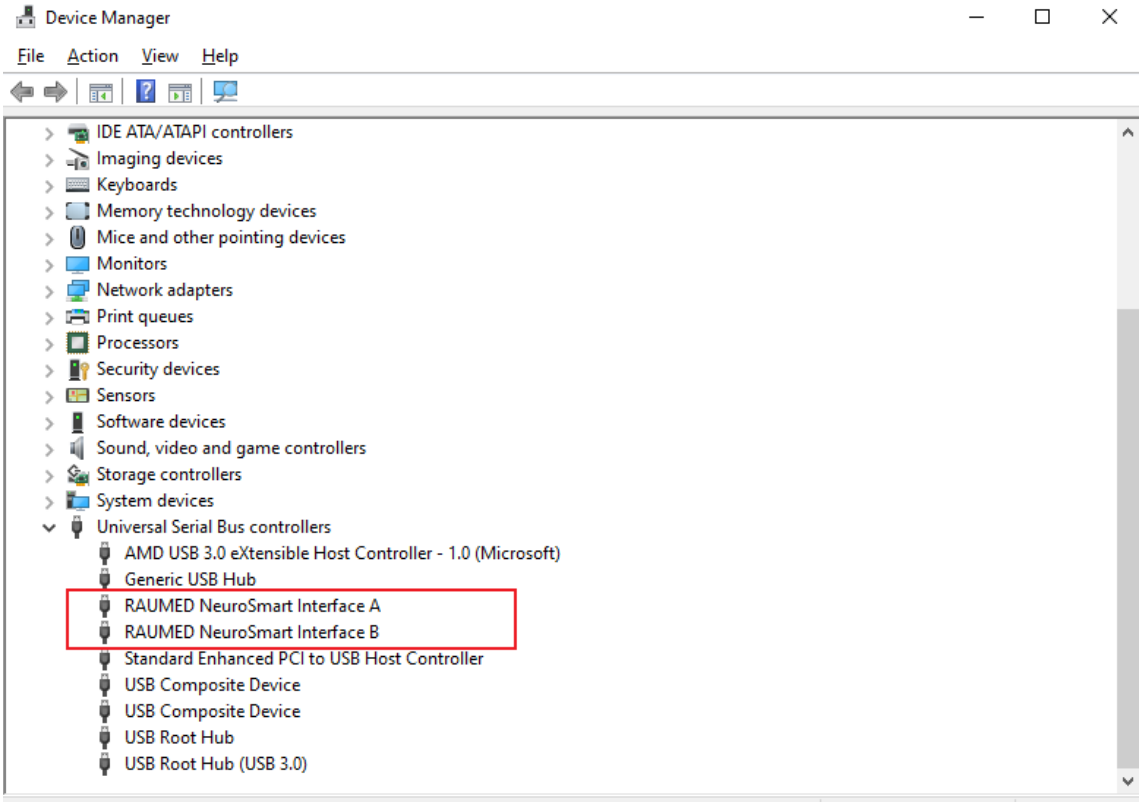
Installing Raumedic driver

In order for ICM+ to be able to connect to Neurosmart monitor the correct **driver needs to be installed BEFORE** the monitor is connected to the ICM+ laptop using USB cable.

The driver to use is FTDI USB-Serial driver provided by Raumedic (available to download from the ICM+ website, the resources section in the User area).

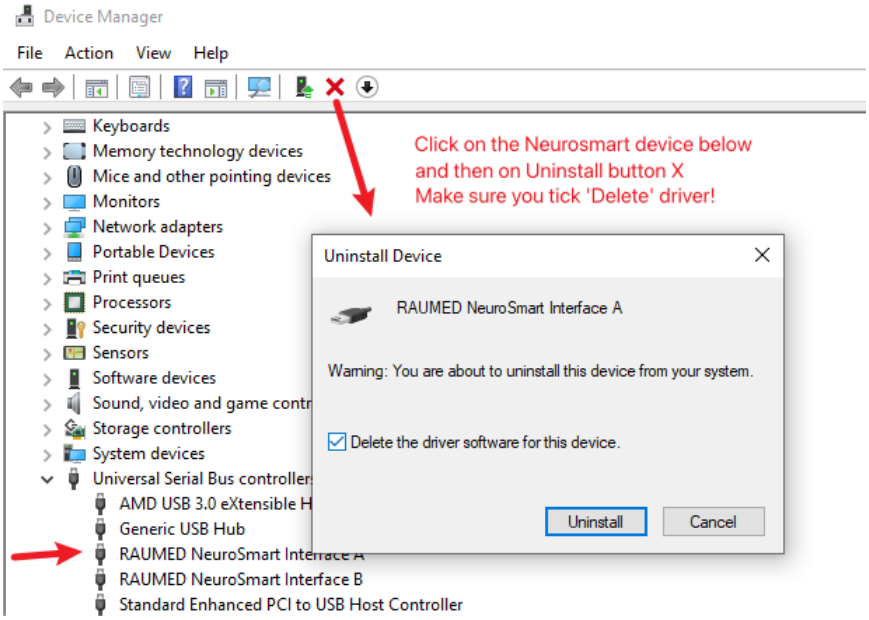
The sequence is important as otherwise the connection will not work.

1. Install the driver
2. Connect the monitor
3. Check if the driver is registered, using Device Manager (type 'device manager' in the search box)



4. Test the connection using Device Editor dialog in ICM+ (see 'Manually configuring data collection' in this document)

Note : If you have previously connected Neurosmart monitor without installing the correct drivers Windows seemingly installs the drivers, and you will see a picture as above. However, ICM+ will not be able to connect. In this case you have to manually uninstall and delete the drivers first!



If the Neurosmart is connected you will see the devices listed as above. If it is not then click on View -> Show hidden devices, and they should show, greyed out, but you will still be able to select them and remove them. Once the drivers are uninstalled make sure to **disconnect the Neurosmart from the computer** and proceed with the correct installation above.

Please note that for Windows 11 Microsoft Visual C++ 2010 Redistributable MUST BE INSTALLED first, before installation of the driver. These are provided for you in the Resources section of the ICM+ user area.

Once this is all done please check again if RAUMED NeuroSmart interface A and B is listed in the Universal Serial Bus controllers, as in step 3 above. You may need to restart the computer.

Locking and unlocking ICM+

ICM+ includes a simple system of user based permissions, which allows it to be used safely in a clinical environment, also by people with minimal training, ensuring that the vital data collection process is not inadvertently interrupted or disturbed.

If your ICM+ is correctly configured when the program is run it will automatically initialize with the default user 'Nurse'. There are three other users already configured in ICM+, the Administrator, the Manager and the Operator. The users have been configured with progressively decreasing operational rights.

The **Nurse** is the user with the fewest rights in the software, effectively only being able to insert clinical events, browse the charts and starting new sessions, without any possibility to disrupt the data collection procedure. Please refer to the 'How to use the events form' for more details. After 3 minutes of inactivity, ICM+ automatically logs in as a Nurse.

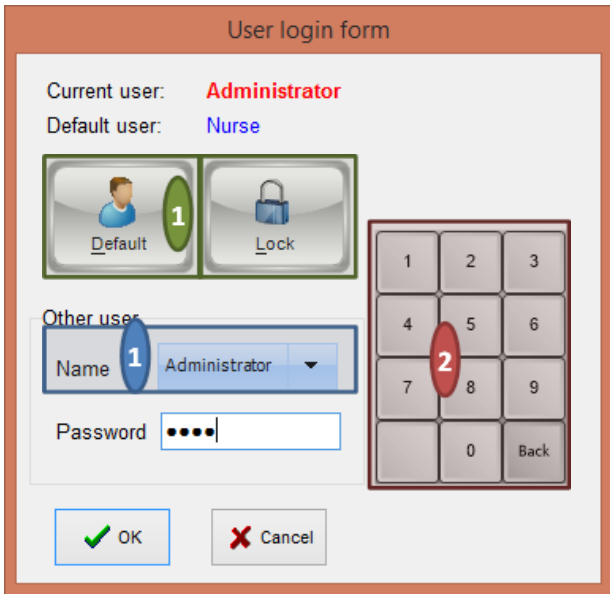
The **Administrator** is the user that will have full access to the full features of the application.

The **Manager** will have the same privileges but will not be able to manage user accounts.

The **Operator** will only be capable of starting new Recording sessions with available profiles, browsing data, inserting clinical information and display configuration.

Login (change users) form is accessible via a button on the tool bar/main menu bar.

When the Login button is pressed, the User login form will appear.

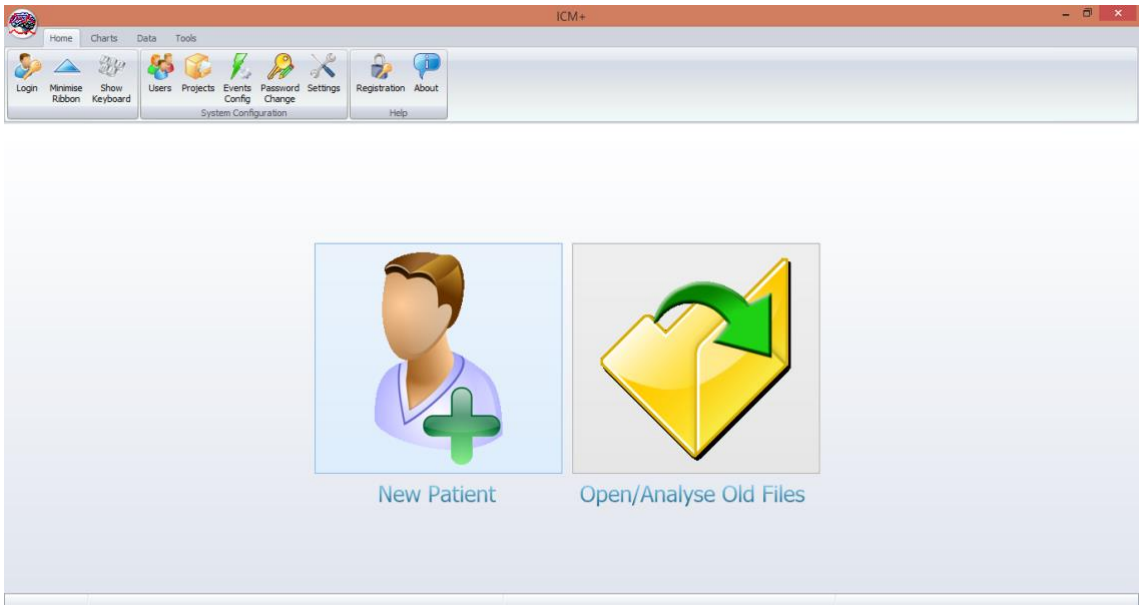


In this form you will find:

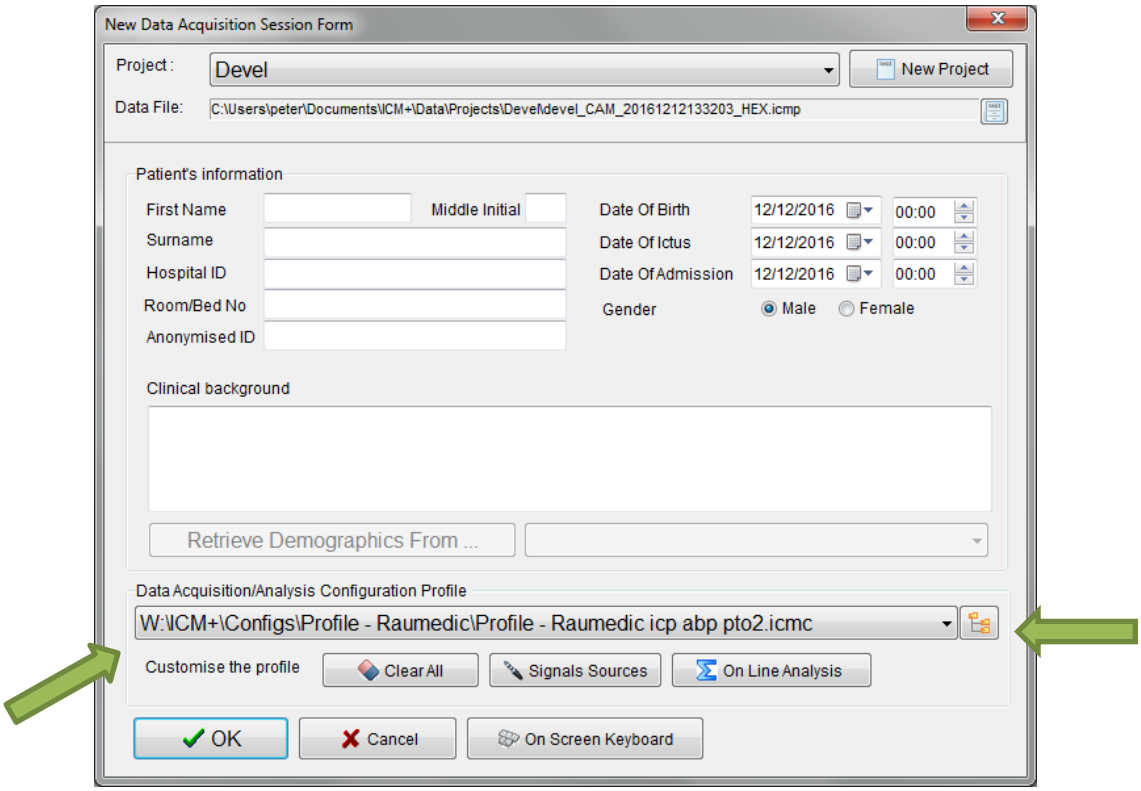
1. A button to the Default user and a button to lock the application so that nothing but the login button is accessible.
2. A key pad to insert the Password for a given use.
3. And a Drop-Down menu to select the user to Login in as

Starting a new data collection session

To create a new data acquisition session hit New Patient button.

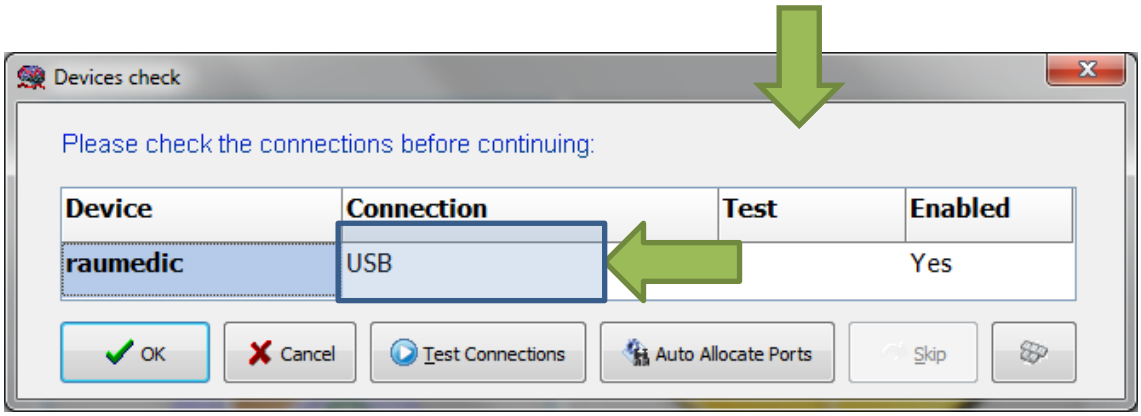


This will bring up a new form, where patient details can be inserted:



More importantly a data acquisition/analysis profile (configuration) file should be selected, either from the history list box or loaded from the file system. These can then be modified if necessary using Signal Sources editor, or On Line Analysis editor.

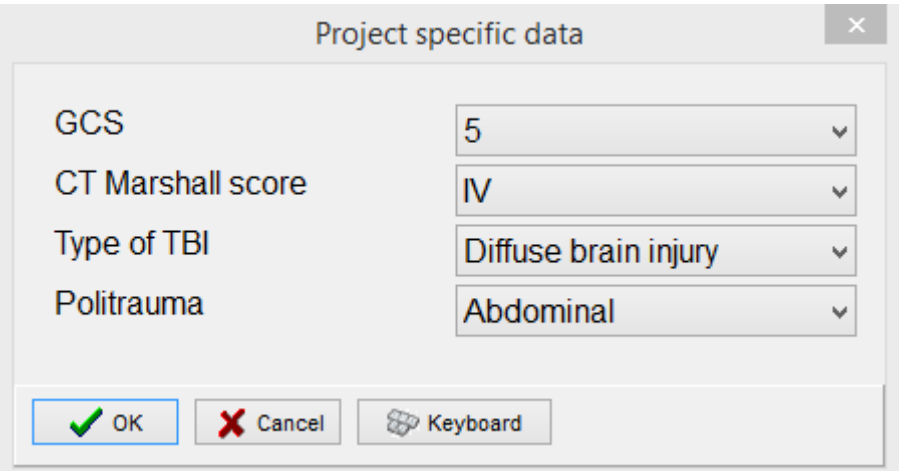
After the OK button is clicked, the Devices check dialogue is presented.



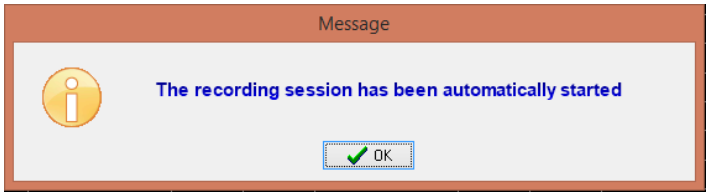
This dialogue is used to test the communication between the ICM+ and the monitor (the 'Test connections' button). If the test is successful the OK button can be pressed.

This menu can also be used to select the right connection, whether it is a serial connection (like the one presented in the picture) or an IP address. In the case of a serial port connection, the button auto allocate ports can be pressed and the application will search for the right port.

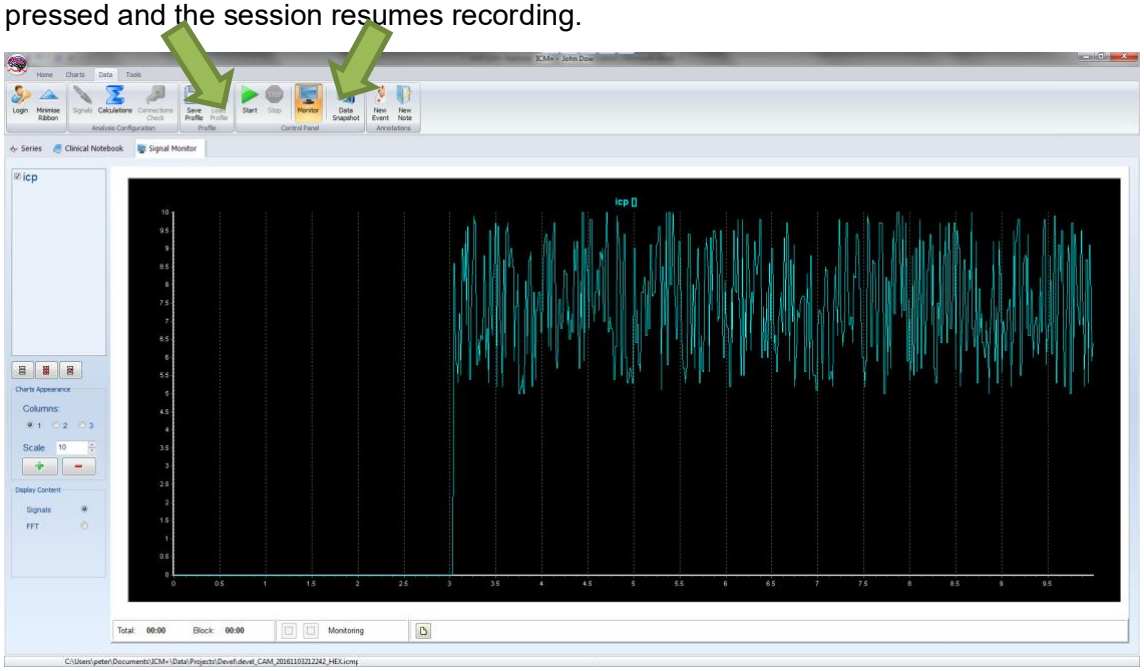
Just before the session starts, the user is prompted to insert some additional information about the patient, if configured, via the Project Specific data dialogue. This form is also accessible from the Patient Notebook tab but it is highly recommended that it is filled in, as much as possible and practical to do, at the start of the session.



After this dialogue, ICM+ main display is presented and the session begins recording automatically, if configured in the used project. Otherwise use Start button (see next page).

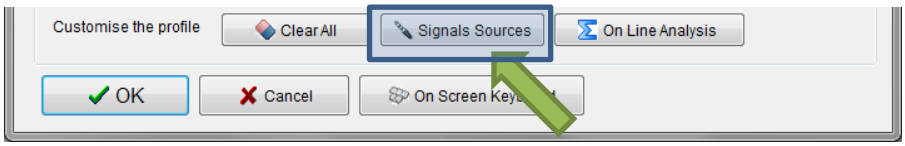


If ICM+ **shuts down during a recording session** the next time it is run, the previous session is automatically restored, but here the user must first verify that all the signals are being received correctly in the Monitor button. After this the Start button must be pressed and the session resumes recording.

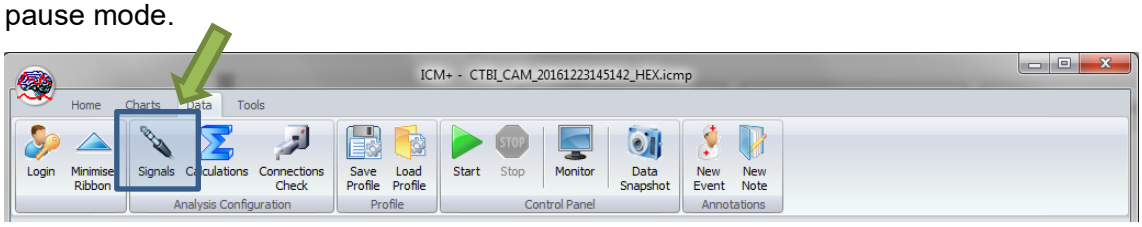


Manually configuring data collection

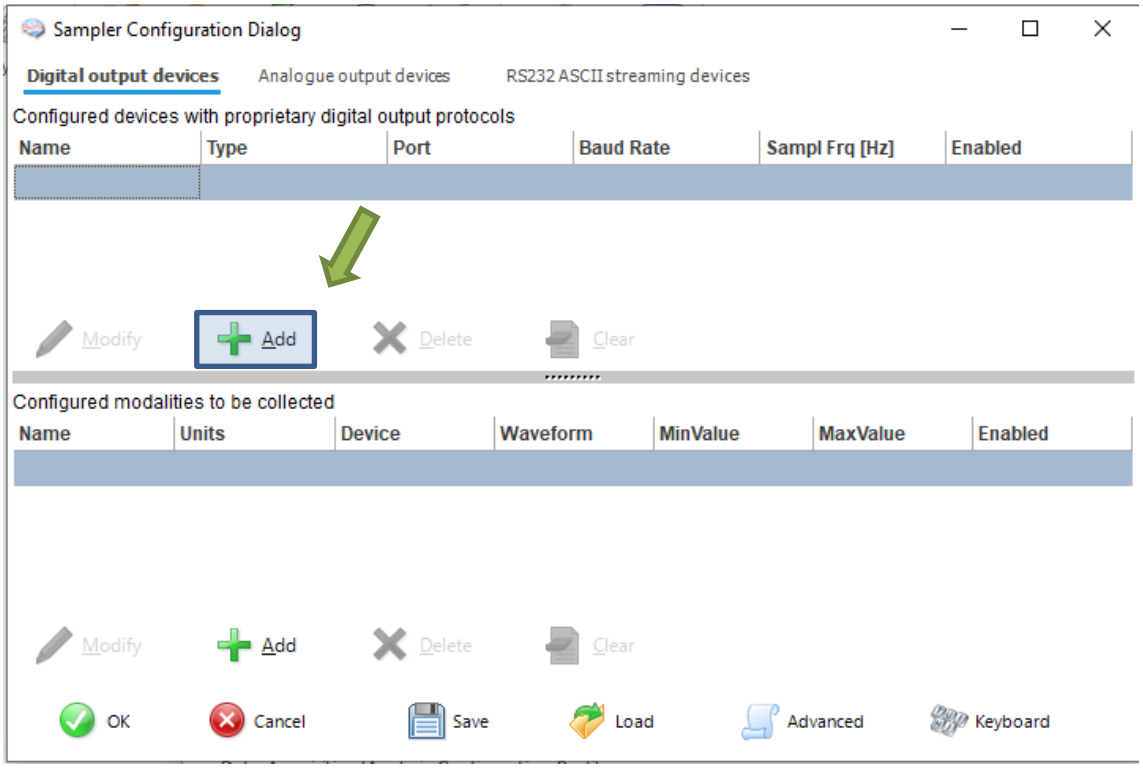
If there is no prepared profile available that includes desired data collection from the monitor or if there is a need to modify or add parameters downloaded from the monitor Signal Sources option needs to be used. This can be done in the New Data Acquisition Form:



Or using Signals button in the main Menu (Data Section), with the data acquisition in pause mode.

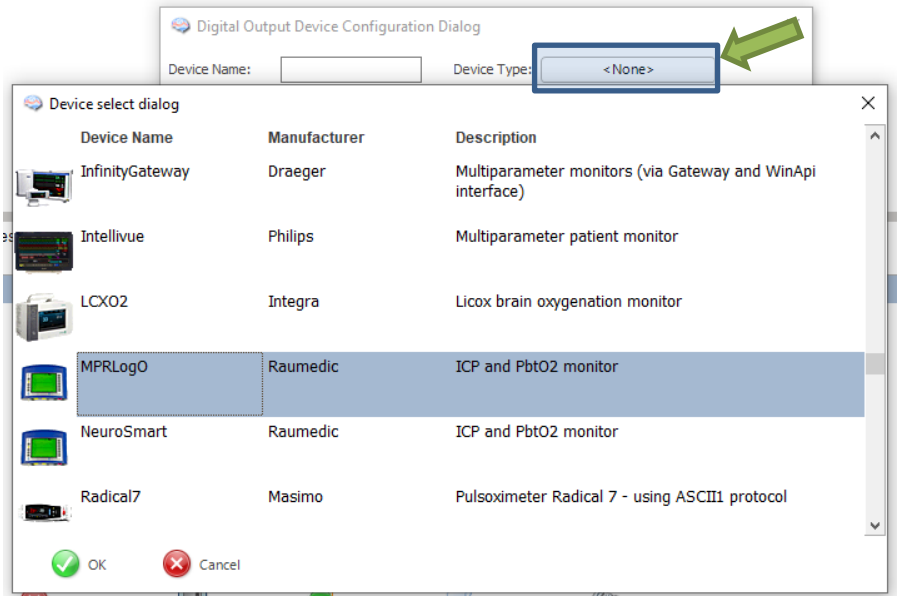


This brings up the Sampler Configuration form:

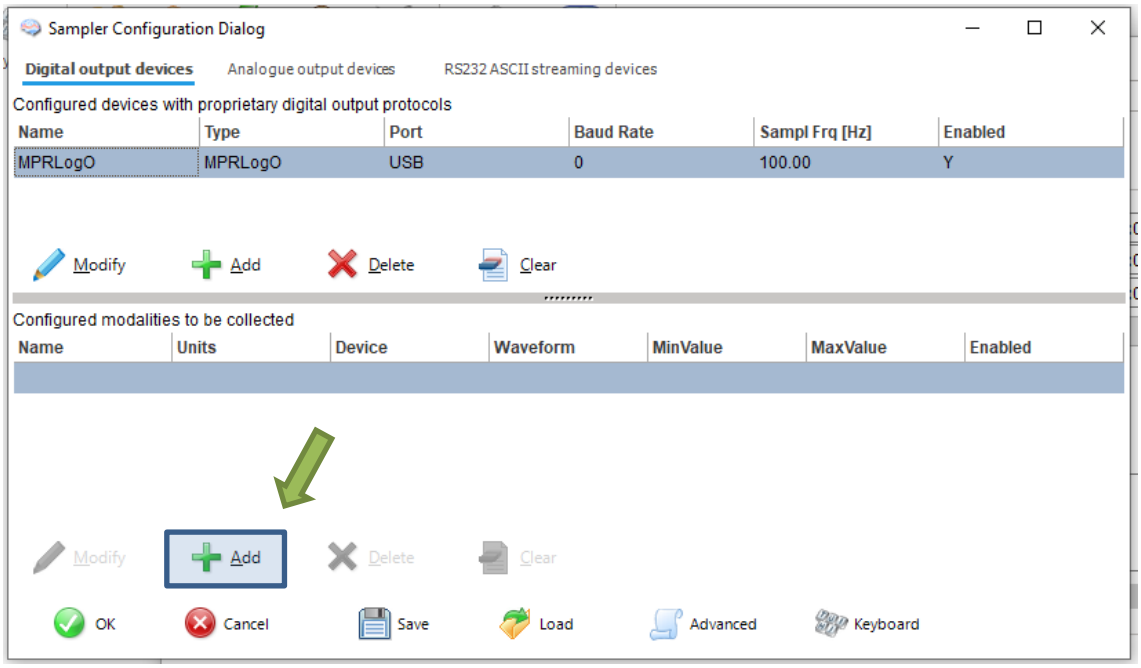


Clicking on Add button in the upper part (Digital Output devices tab) opens a Device Configuration dialog. Here, one can select the monitor module from the list of available

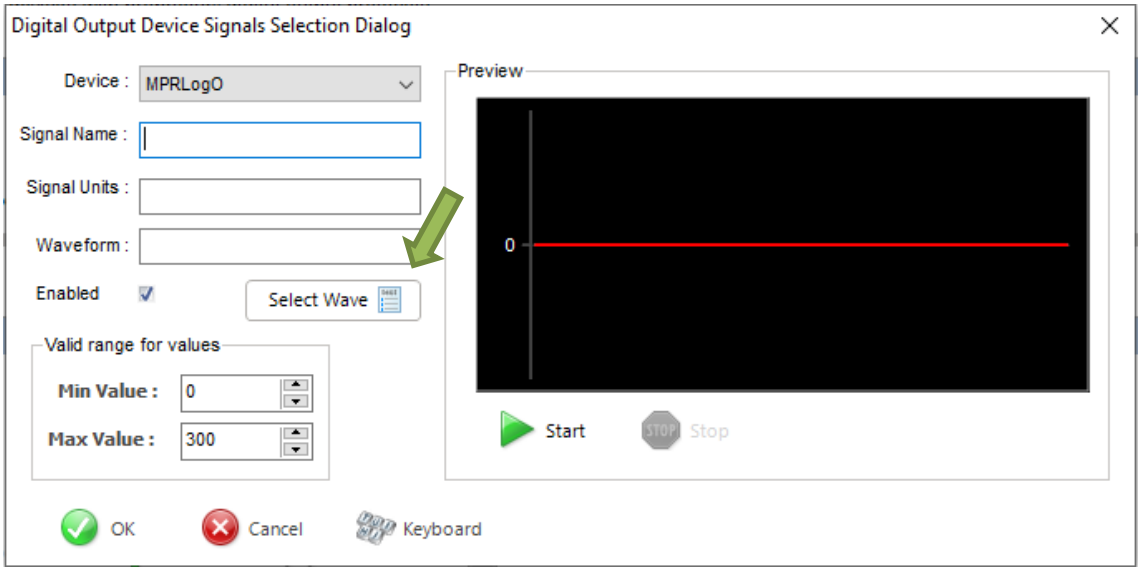
(installed) interfaces, as well as specify the serial port (real or virtual, when using USB-RS232 adapter) and its baud rate to match the one configured/offered by the device.



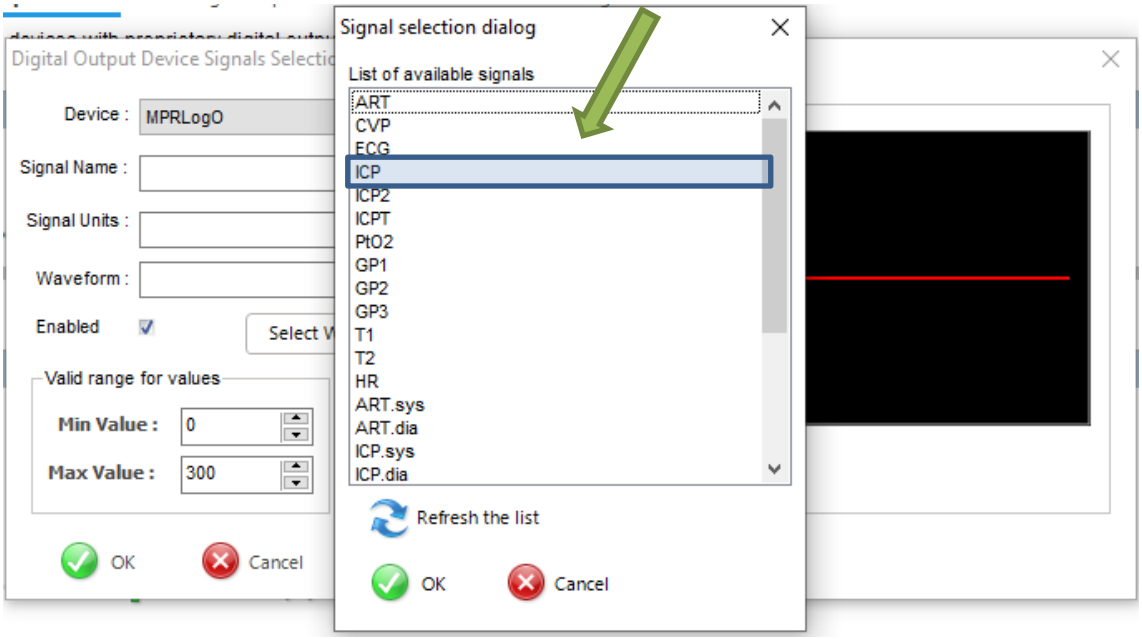
Closing the dialog will the device to the data collection configuration. What remains to complete the configuration is adding to the configuration all the desired parameters to be downloaded. This can be achieved by using the Add button in the lower part of the Sampler Configuration dialog.



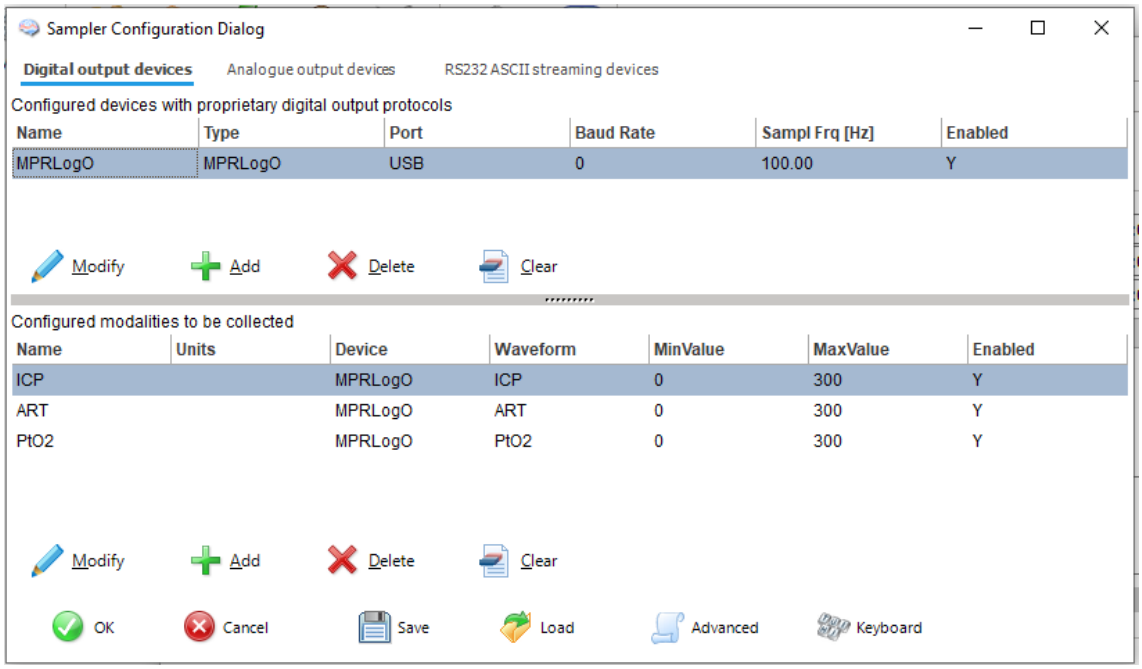
This opens a signal selection dialog:



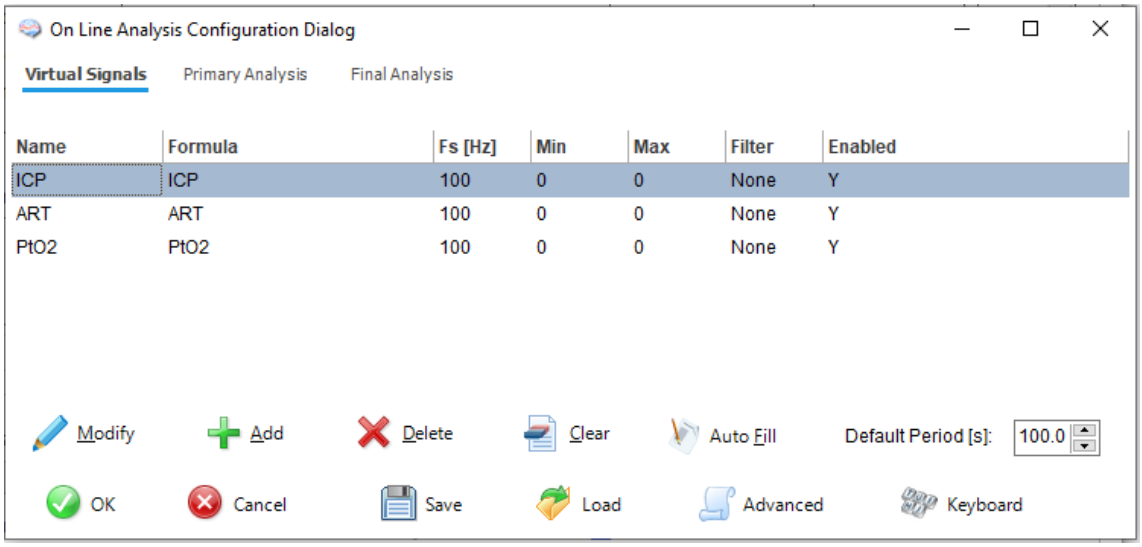
Using the Select Wave button one can select available signal, one at a time.



This process can be repeated as many times as it is needed putting together the complete list of parameters to be collected, which complete the data acquisition configuration procedure.



Please note, that adding parameters/signals to the data collection will make ICM+ show and record the data through the Signal Monitor window but the trends charts will not automatically get configured to show them. This is because the trend charts only show results of calculations, not the raw data. So to display even just a mean trend of a newly added variable collected from the monitor ICM+ this needs to be configured first in the analysis section, as in picture below, and then the new trend added to the charts.



Annotating clinical events

As soon as the acquisition of data starts the main menu tool bar will get minimised and in its place a small, ‘data acquisition essentials’, tool bar will open, as below.

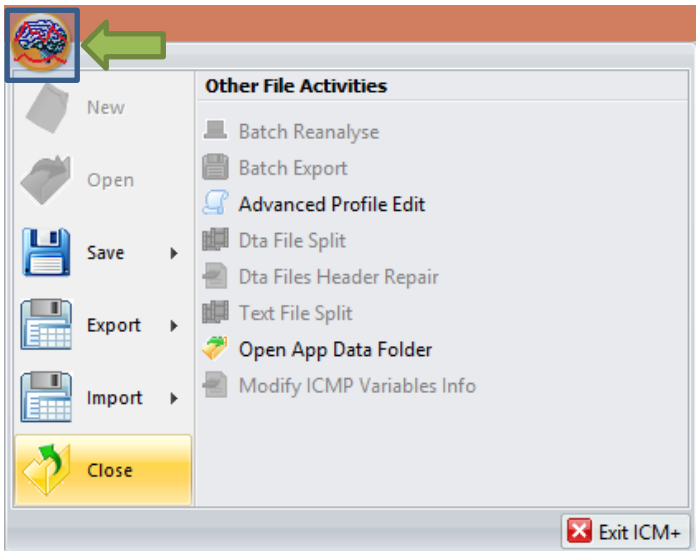
There, from left to right the following functions are accessible:

1. Log-in/Log-off form – to change the user (ie privileges)
2. Event annotation form
3. Free textual annotations form
4. An on-screen keyboard
5. The last button closes this tool bar and unfolds the main men toolbars

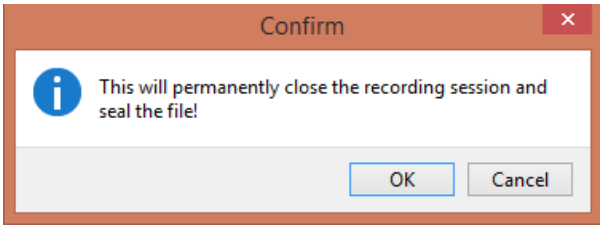
Terminating the data collection session and uploading the data

When the data acquisition process is finished the recording session can be closed using the Close button present in the ICM+ button. This will initialize a cascade of forms that will eventually lead to the sealing of the file and subsequent archiving the data to the file server, if required.

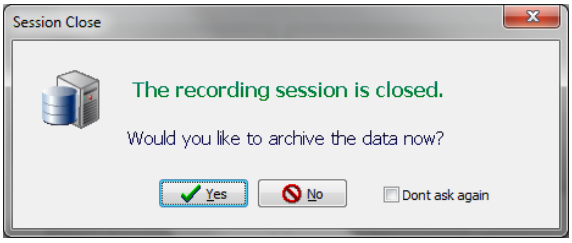
Closing a session is different from closing the program. To close the ICM+ application you need to press the red cross present on the upside corner of the right side of the screen. If ICM+ is closed (Exited) using this button or if the computer shuts down, the next time it is run, the recording session will be resumed with the same configurations it had at the moment of shutdown.



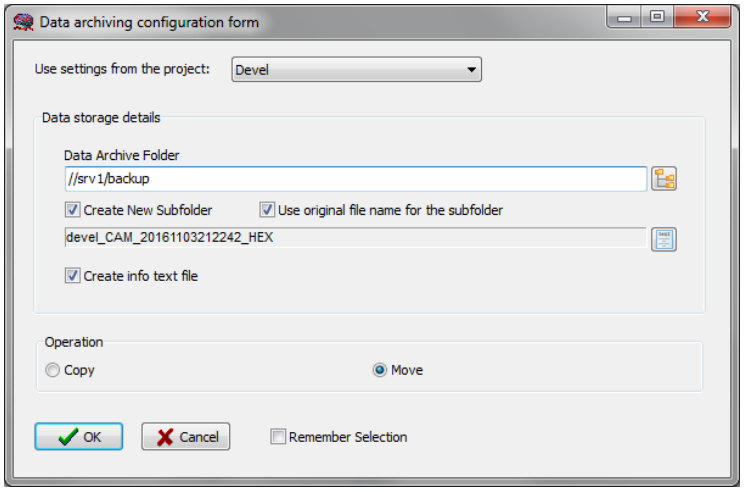
When this button is pressed a dialogue is presented prompting the user to confirm the closure of the recording session:



After confirming the end of the recording session another dialogue is presented prompting the user to archive the data:

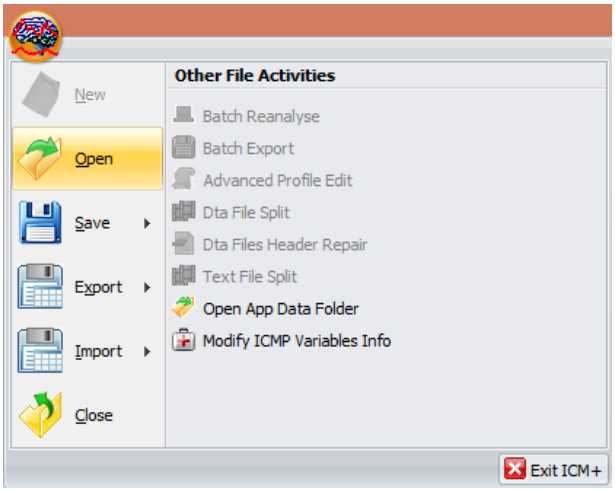


After confirming this dialogue the Data Archiving Form is presented, where the user can specify/confirm the location of the server and its share to use:

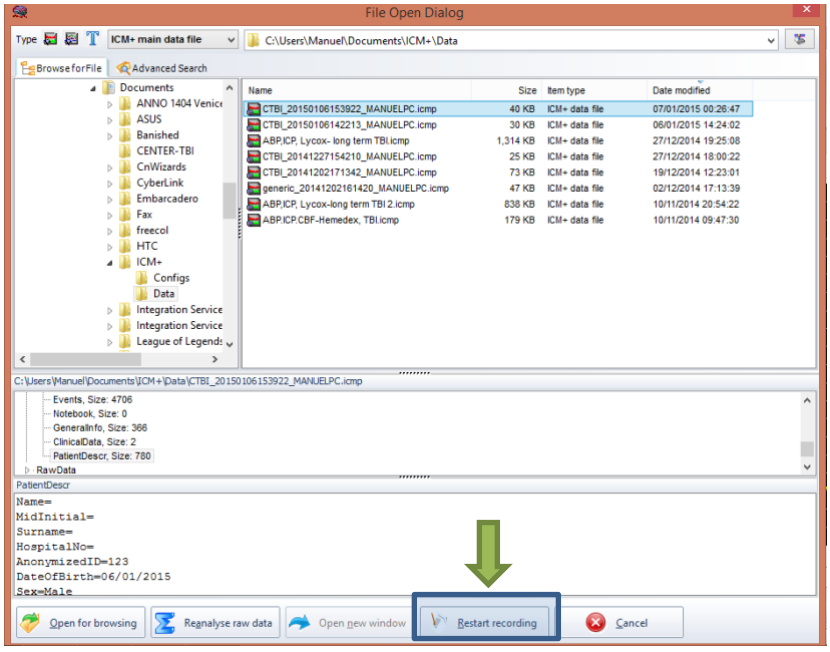


Restoring a closed data collection session

If a session was for some reason closed and a recording needs to be restored again the button open can be pressed.



The dialog that opens can be used to reopen the file in order to upload the data to our servers or to restore the recording session.



To reopen a file for inspection or to upload it is only necessary to double-click the desired file.

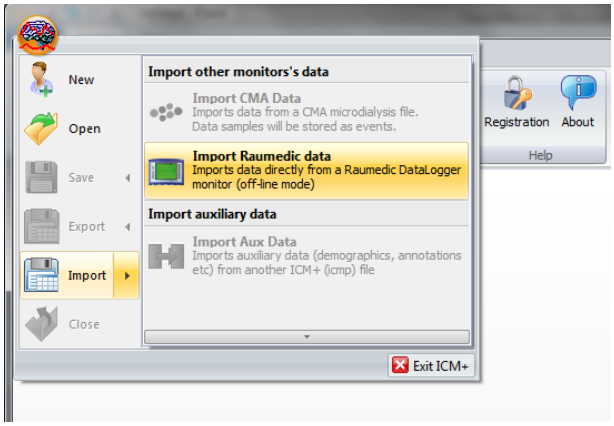
To restore the recording session, the highlighted button must be pressed and the recording resumes using the same profile as when it was closed.

Importing data stored in the memory of the monitor

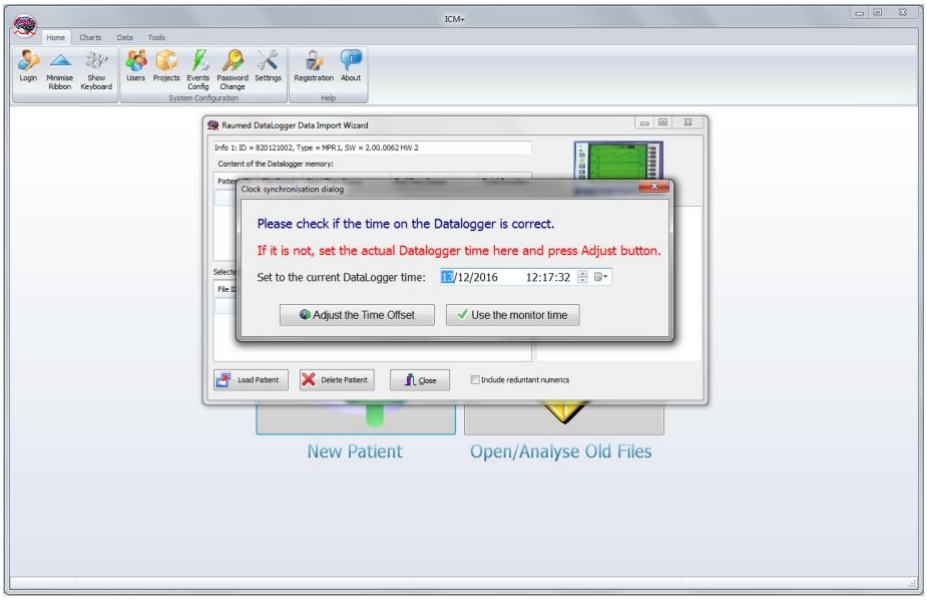
ICM+ can also import (and analyse) data recorded and stored in Neurosmart (or the older DataLogger) memory. This is a very useful feature as the monitor does not need to be attached to a laptop for data recording to take place.

As a prerequisite the monitor must be in off-line mode (that is not collecting data). If that is not the case it needs to be switched off and back on again, but without restarting the data acquisition process.

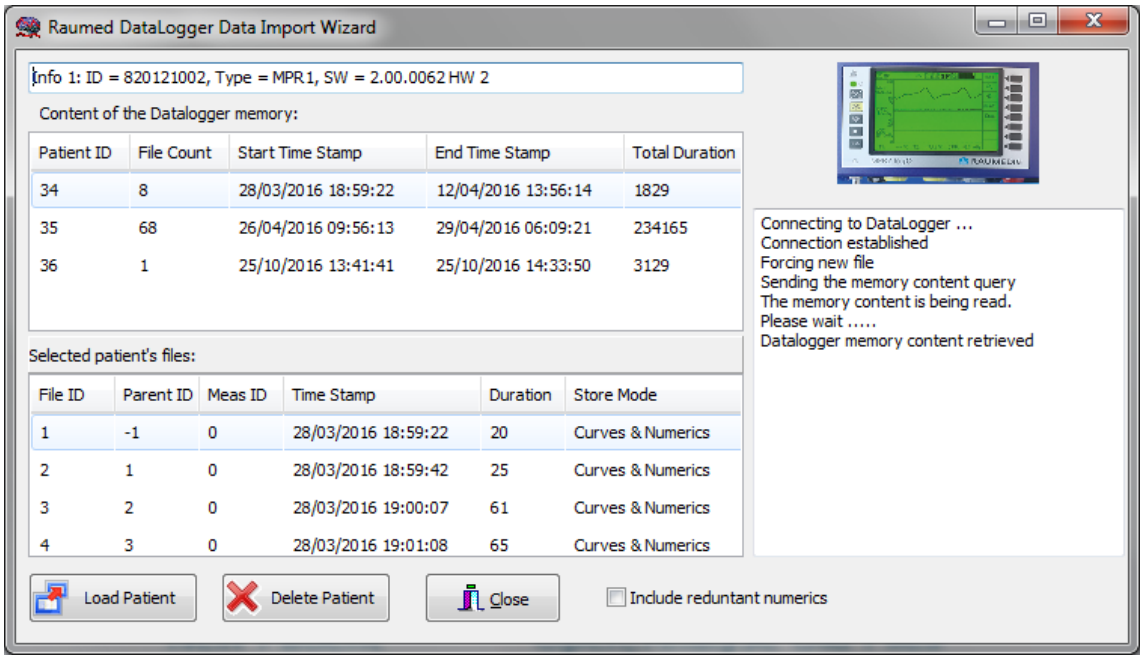
Then in ICM+ go to the Brain icon , and click on the little arrow next to Import item in the menu. Then select ‘Import Raumedic data’, or ‘Import Neurosmart data’, whichever is relevant.



This will open up a Raumedic import dialog, and if this is the first time this wizard is run after starting ICM+ a little dialog appears that allows to synchronise clocks between the laptop and the monitor. This is important if monitor clock was not set properly at the time of data recording.



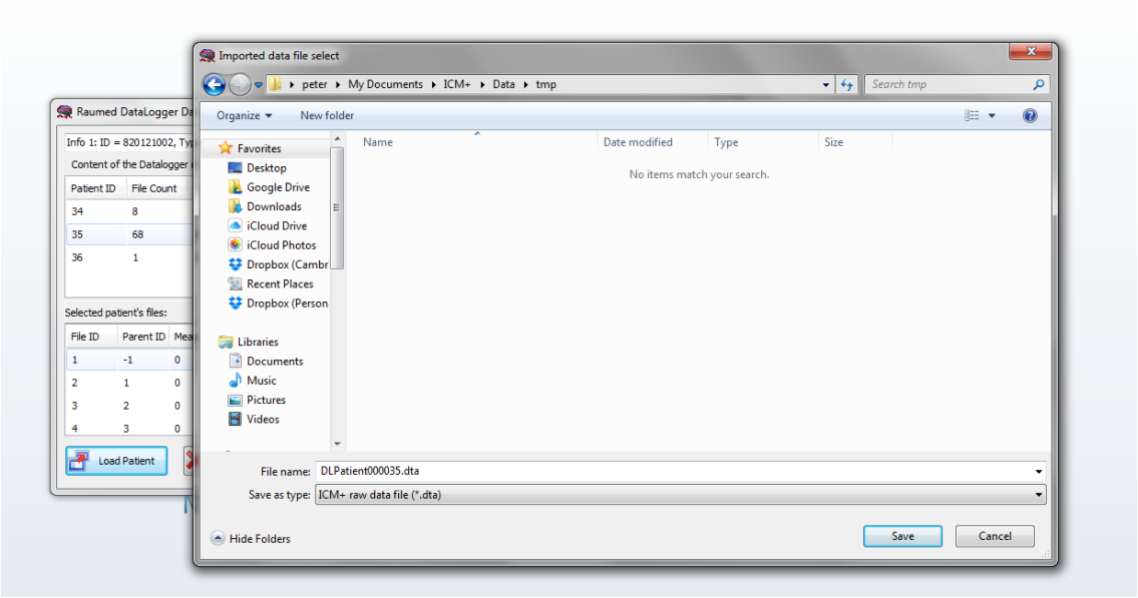
Selecting 'use the monitor time' will keep the time stamps as they come in from the monitor, alternatively the time stamps may be adjusted by the difference between the actual time and the time currently displayed on the monitor. Once this is done the software will take a few seconds to read the content of the monitor's memory. Once this is completed the following screen will be shown:



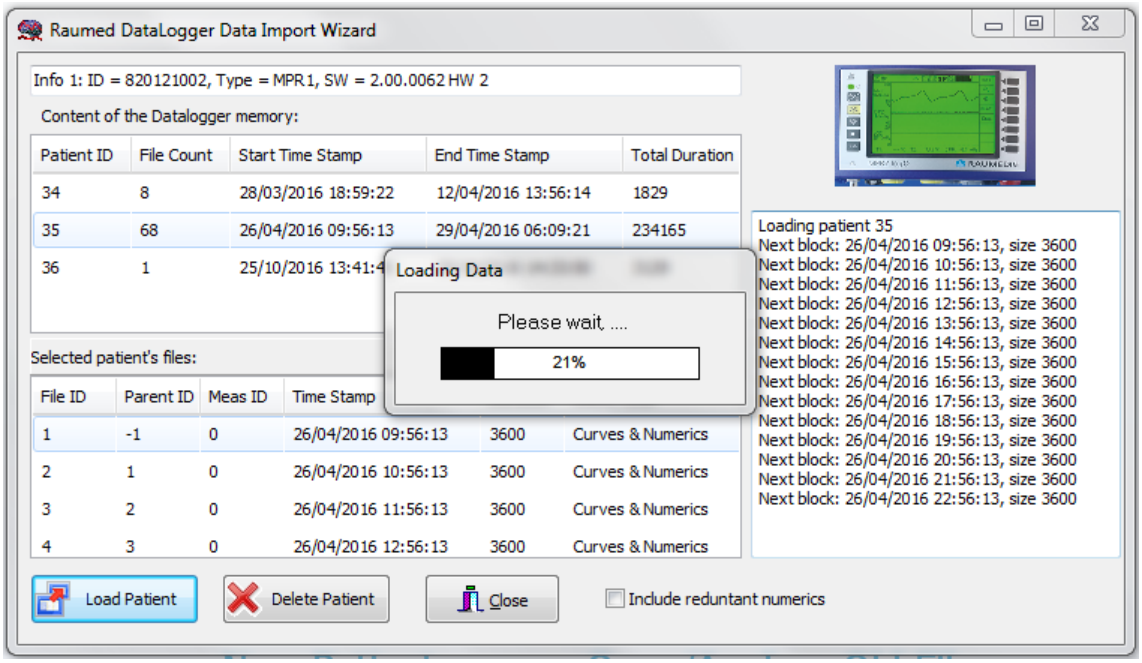
This form shows the identification string returned by the connected monitor (top row), list of patients currently stored in the memory (total duration given in seconds), and list of data blocks and their details of the selected patient. From here clicking on Load Patient will start importing data of the selected patient. By default pressure numerics (ie mean/syst/diast values of pressures) will not be imported if full pressure waveform is available as those can be calculated by ICM+ from the waveforms. Ticking 'Include

redundant numerics' will import those as well (but the file size will get heavily inflated as all the numerics will be automatically upsampled to the waveforms resolution) of 100Hz.

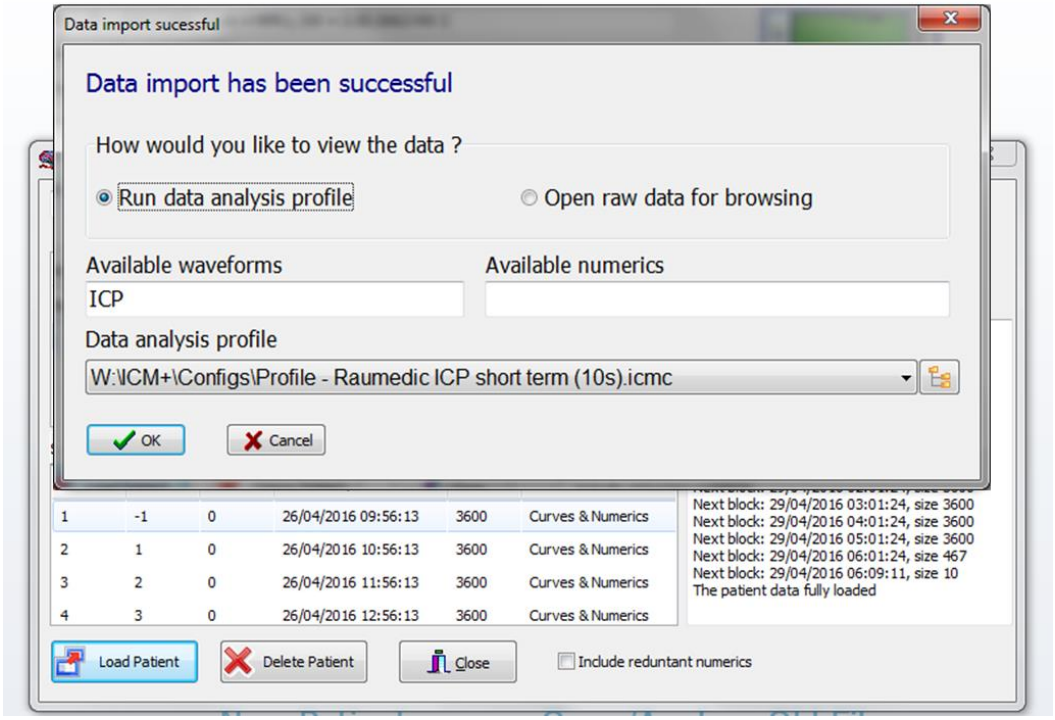
To import particular patient's data click on select the patient (which will cause the patient's data stream to be listed in the bottom half) and then press Load Patient button. This will cause a save dialog to pop up asking you to choose the location for storing the imported data file. The file name will by default have a format 'DLPatient<Patient Number>.dta'. This can be of course changed to a more suitable name. This file will contain raw, imported dta (at 100Hz , if waveforms were present, or 1Hz if only numerics were available). If the data file grows too large it will automatically get split into several dta files with the same names and suffix _r1, _r2 , _r3 etc, which makes it more practical for browsing the content of large raw data files. Please not that the analysis that follows the data import will be nevertheless automatically done on the whole imported data set and stored in one file with trended values.



Once the imported data file location has been chosen clicking on Save will start the process of importing. A progress indicator will be displayed showing the proportion of imported data and the log window will list imported data blocks.



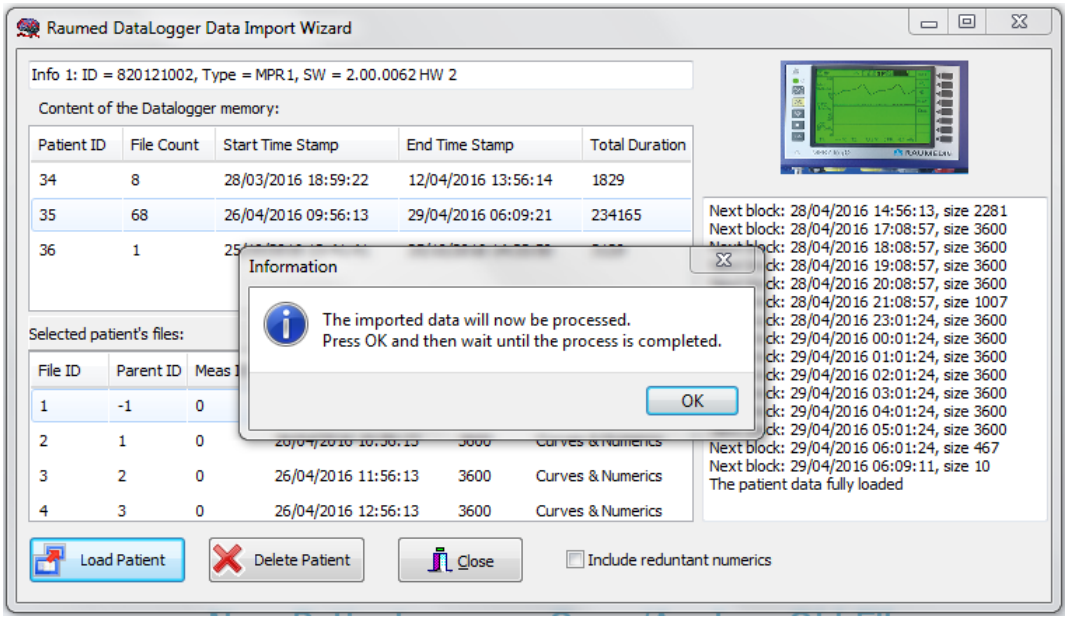
This process can take a little while, several minutes, if more than one day worth of data is being imported. When this is done the log window will report that the data has been fully loaded and the import post processing dialog will show up. From here the user can request the raw data to be displayed in the charts (if the file has been split into several the content of the first one will be shown), or to analyse the raw data using one of the prepared analysis profiles.



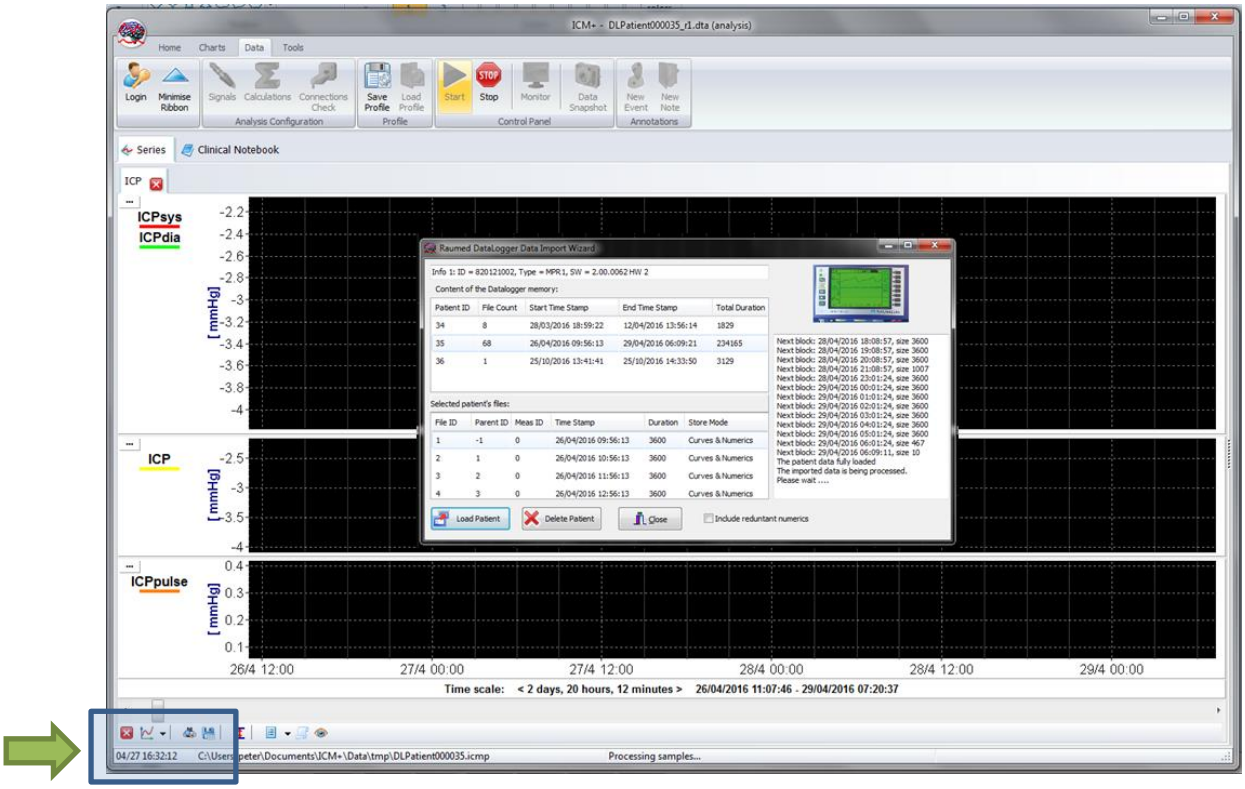
There is a profile history combo box with the last profile used already selected. Other ones can be loaded using the little folder tree button next to it. The analysis profile has

to be configured to use the variables (waveforms and/or numerics) that are available in the imported data set. These are listed in respective boxes in the dialog.

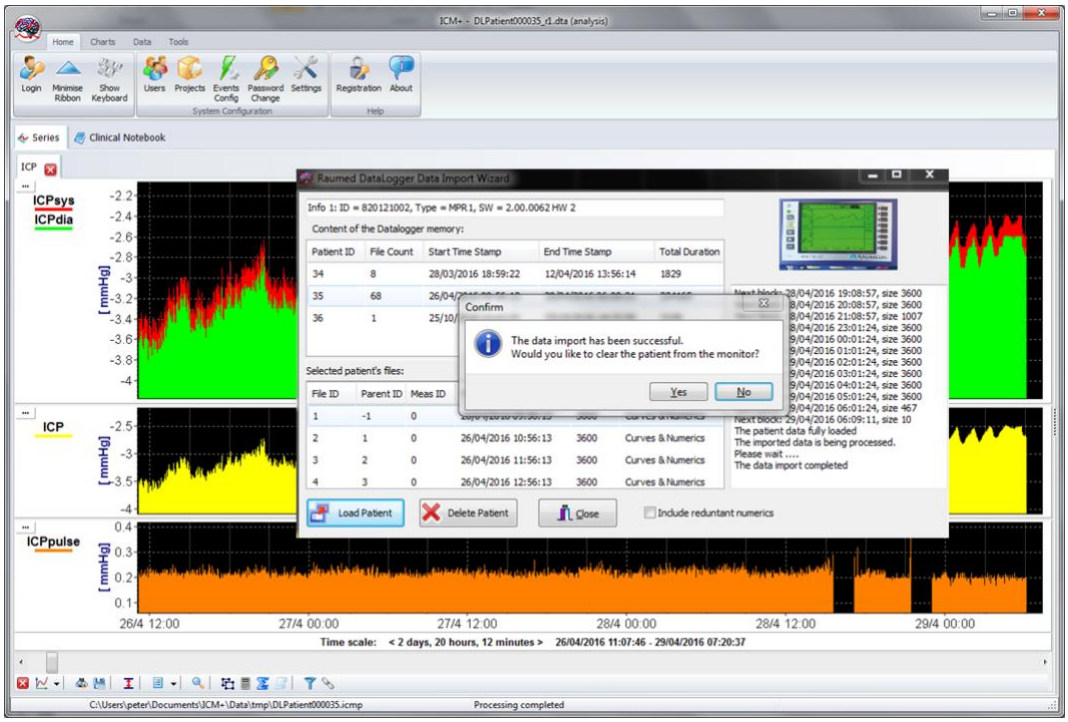
If the 'Open data for browsing' is selected the dialog will close and ICM+ will load the file into its charts. On the other hand, if 'Run data analysis profile' is selected ICM+ will load the charts layout (as configured in the loaded profile) and start the process of processing the raw data file(s) according to the prescribed analysis.



During the analysis process ICM+ the Data Import dialog will remain open but the charts will not update until the end. The only feedback given that the analysis is on going is the time stamp updated in the left bottom corner of the ICM+ charts screen.



Once the calculation are done, which can take from few seconds to few minutes, depending on the size of the data and the complexity of analysis configured, the charts will fill in with the calculated trends and a confirmation dialog will be displayed.



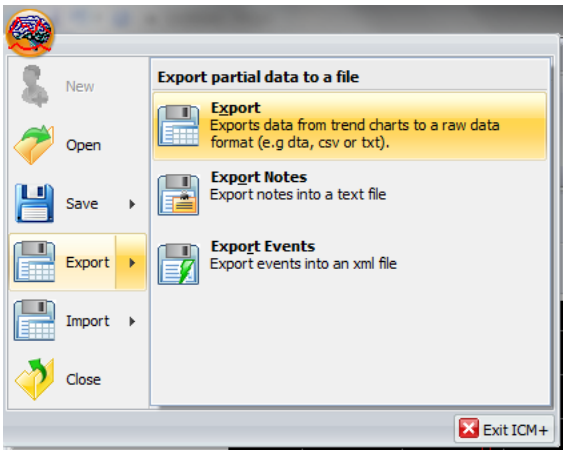
At this point the user has an option to clear the imported patient from the monitor's memory, or to do that later once the imported raw data files are safely archived (using the 'Delete Patient' button of the Raumedic Import Wizard dialog).

The calculated trends are automatically saved into a different file, with extension icmp bearing the same name as the raw data file analysed, so that it can be retrieved later without the necessity of re-analysis of the raw data file(s).

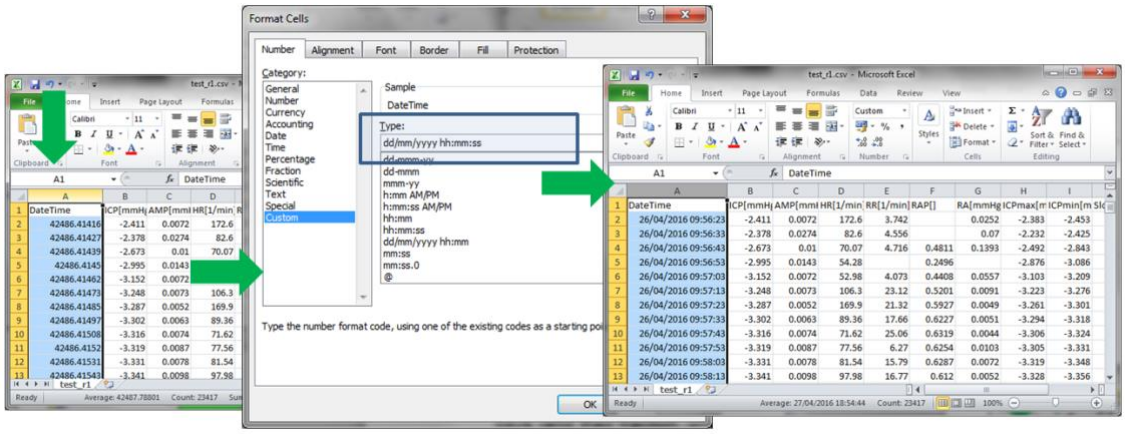
Pressing either Yes or No to this last query will cause the connection to monitor to terminate (which takes a few seconds) and the import dialog to close, leaving the user to browse the analysed (or imported raw, depending on the selection following the data loading part), data.

Exporting data to a csv (Excel) format

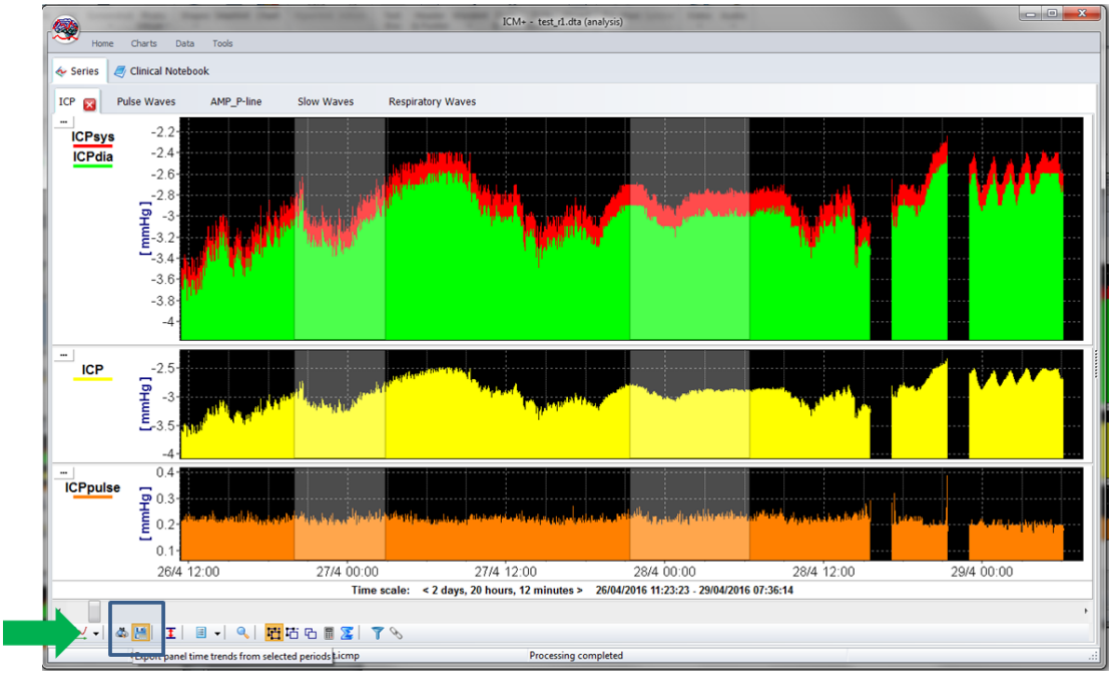
There are two ways the data can be exported from ICM+. One way is to select Export option in the main menu (the Brain icon).



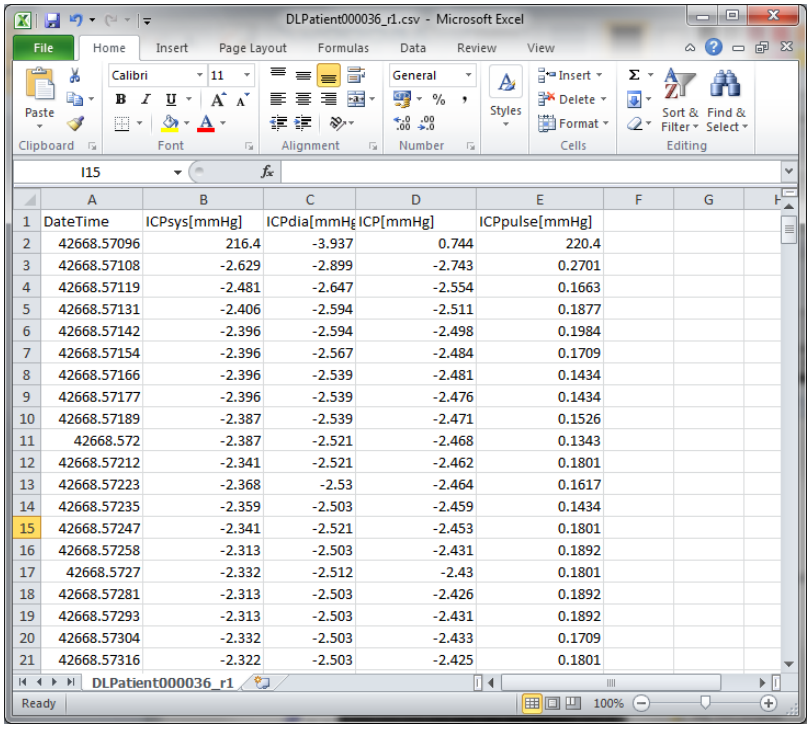
This will export all the trend data from the memory, all the variables, in commas separated columns of values, with the first column containing the time stamps, in the internal Windows DateTime format. The DateTime format is essentially a number of days (and their fraction, which translate into time) since 31/12/1899. Imported into Excel it will initially showed up as those numbers, but if date or time (or combined) cell formatting is requested for that column the data and or time will be shown.



The second way of exporting data is to use the data export chart tool, located at the bottom of each charting vertical panel:



This will export data only from the variables plotted in the panel corresponding to the button toolbar, in this case it will be ICPsys, ICPdia, ICP and ICPpulse only, and only from selected time periods, if the selection tool is used, or the whole recording time, if not.



Appendix 1: ICM+ configuration folders and files

ICM+ uses two locations (configurable via the Settings form) to store all its configuration files:

Location 1: **C:\Users\<username>\Documents\ICM+**.

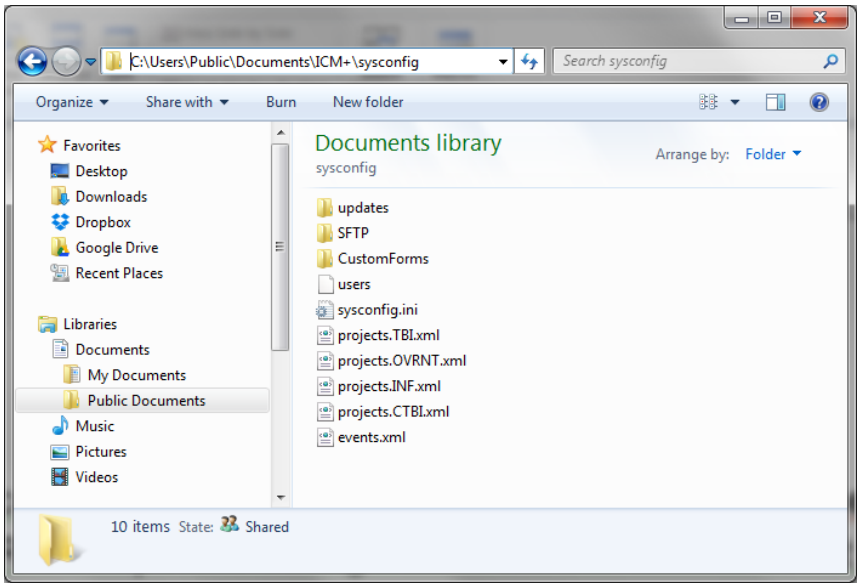
There are two subfolders here:

'**Data'** folder, where all the data recorded during the acquisition process is stored, and

'**Configs'** folder, used to store the data collection and analysis configuration 'profile' files, as in the figure below.

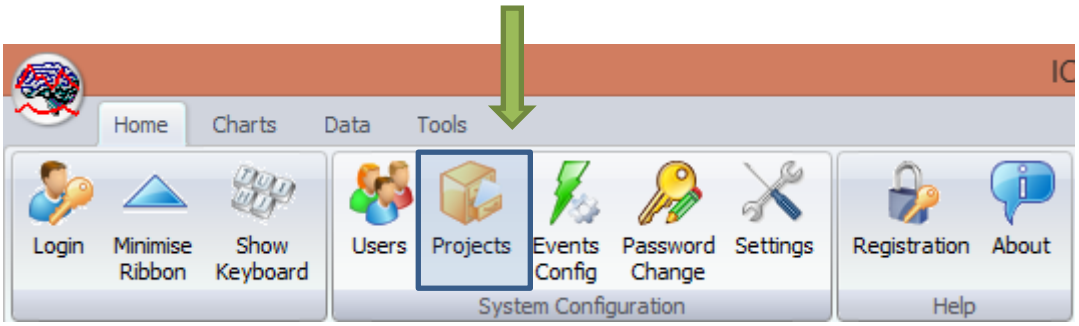
Location 2: **C:\Users\Public\Documents\ICM+**

Here all the environment configurations/settings are stored. This location contains a folder called **Plugins**, where 3rd party function libraries reside, a folder called **TxtFilters**, containing parsing definitions for different text format data files, and a folder called **sysconfig** containing all the settings of the software, except the data collection and analysis profiles which are store in the Location 1 (as above). Although these files could be edited directly using a text editor ICM+ has specific user interface forms to edit all aspects of the program functionality.

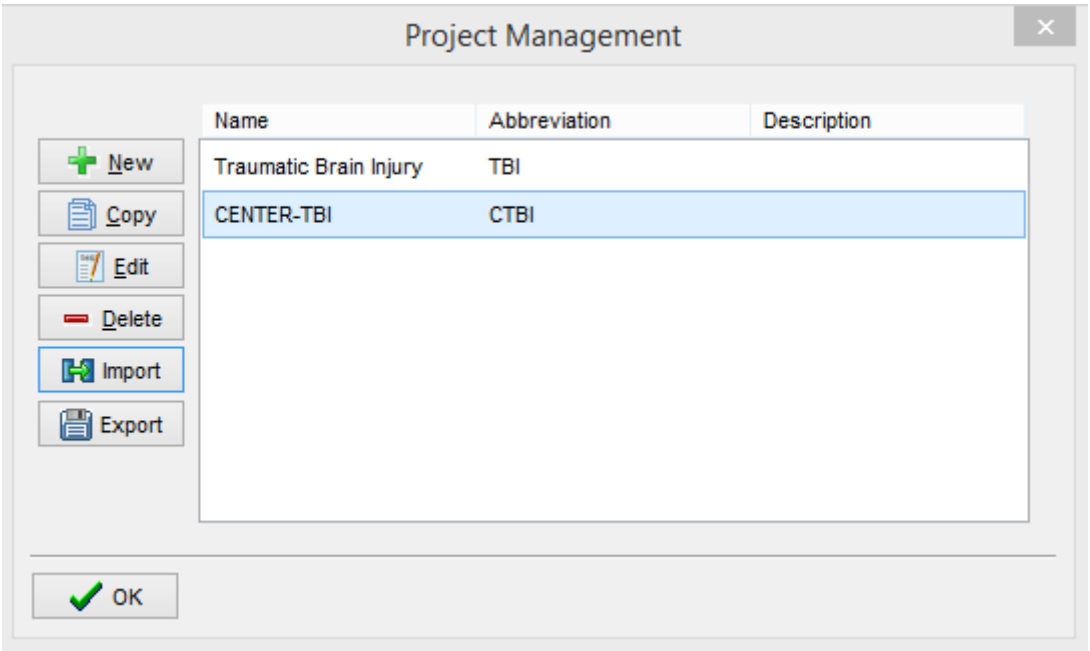


Appendix 2: Editing ICM+ Projects

Projects contain various configurations specific to a particular research project. These can be edited using **Projects** button in the main menu tool bar.

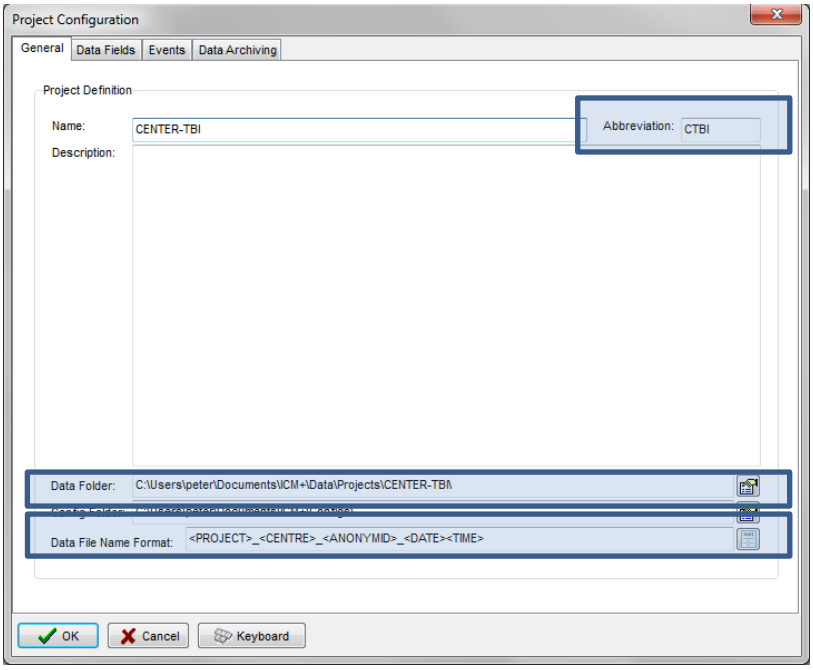


Clicking this button will open the Project Management dialogue, where you create, copy, edit, delete, export/import selected projects to/from a file.



Double clicking on a selected project or clicking on Edit will open a Project Editor where all the custom project settings can be modified.

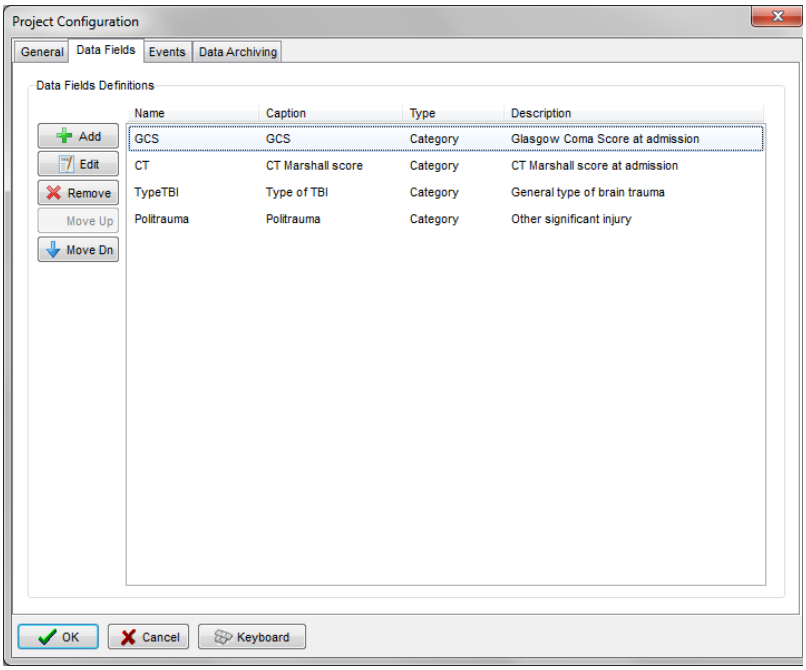
The following screen shots describe the CENTER-TBI specific settings. These settings would have already been preconfigured for you if you have copied the provided project.ctb.xml file to the ICM+ sysconfig folder, or used the Project Manager to import the settings from that file.



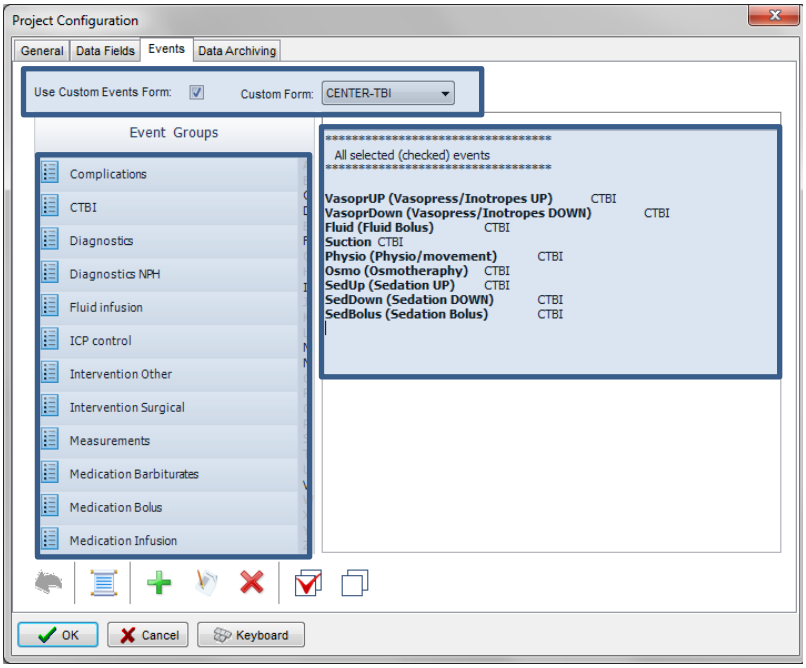
1 . The project **abbreviation** will be part of the file name

2. '**Data Folder'** is a local folder where the data collected as part of this project will be stored

3. **Data File Name Format** lists elements that will be used to create automatic file names for each new data acquisition sessions. Please note that elements listed here will have to be filled in (e.g Centre ID, or the anonymous Patient ID) at the New Data Acquisition form stage before continuing.

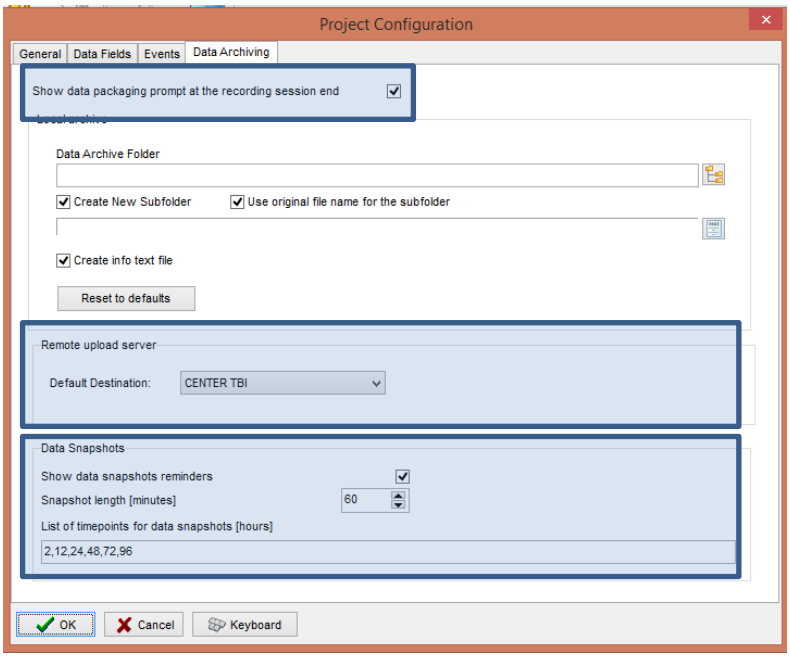


The data fields define placeholders for general clinical descriptors that characterise the patient at the time of admission to the critical care unit, that are useful to be kept together with the monitoring data.



This is where events that are already defined elsewhere (in the Events form), listed in the left panel (1), can be assigned to the particular project (listed in the right panel 2.).

Please note that CENTER-TBI uses a customised event form, selected using the 'Custom Forms' list box (3). It is possible however to add more events to the project but those will only be accessible from within the 'Event List' panel, toggled from the main menu tool bar panel, Charts section.



Here one can define the location and format of data archives as well as, essentially for CENTER-TBI:

1. This should be ticked in order for you to be prompted to convert the file to HDF5 at the end of the recording session

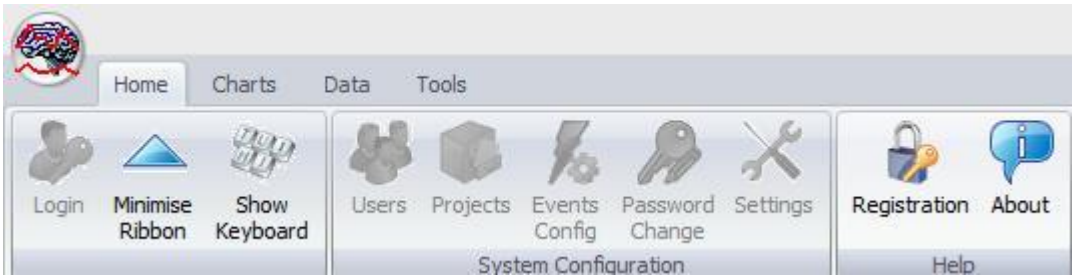
2. the destination of the remote server for data uploads,

3. the data snapshot length and the data snapshot reminders

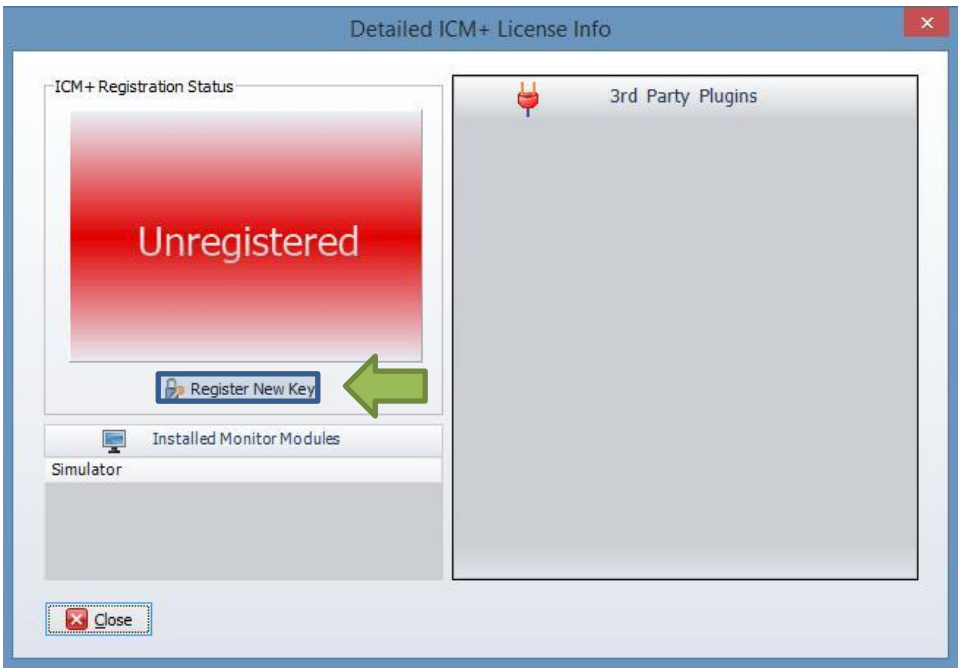
Appendix 3: Registering ICM+

When ICM+ is successfully installed for the first time in a computer it needs to be registered. This will probably already be done for you when you get the laptops, but if any major update needs to be done you will have to register it again.

To register ICM+ you need to press the Registration button on the Home tab.



This will bring up the Detailed ICM+ License Info window where you will need to press the Register New Key button.



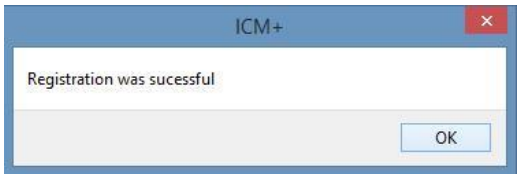
This will bring forth the ICM+ Registration Form and here you will have to press the Copy Details.

In order to obtain a registration key please go to

https://icmplus.neurosurg.cam.ac.uk/user-area/

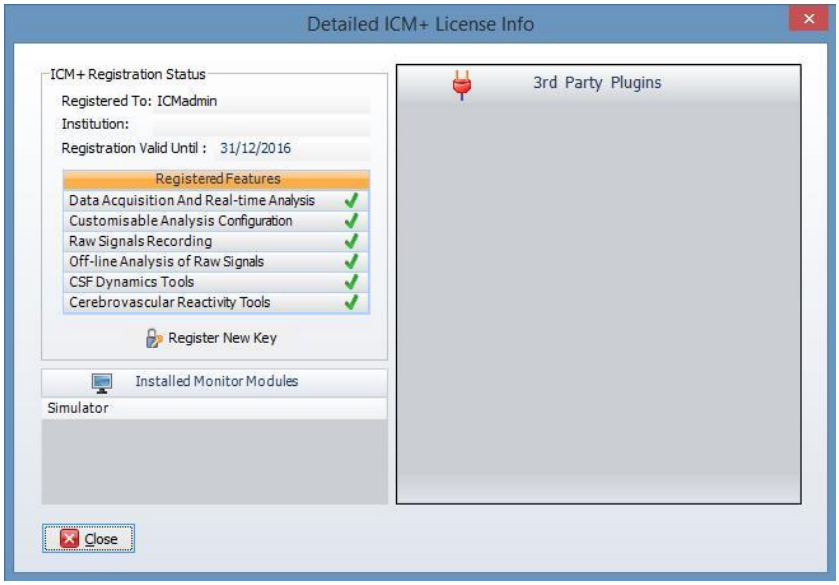
and click on Request New Key button at the bottom of the Dashboard page. You will need to provide details from the registration form above. Once the Request Form is submitted it will need to go through the approval mechanism at Cambridge Enterprise. When that is done an automated email will be generated to the email used to request the key on the website. The key will then be available in the user dashboard page.

You will then have to paste the Key to the highlighted space and click Register now. If you are successful you will see the Registration successful dialogue.



Please note that the lifetime of a key is normally 1 year and the registration will need to be renewed.

And your Detailed ICM+ License Info window should look like this:


Detailed ICM+ License Info
ICM+ Registration Status
Registered To: ICMadmin
Institution:
Registration Valid Until : 31/12/2016
Registered Features
Data Acquisition And Real-time Analysis
Customisable Analysis Configuration
Raw Signals Recording
Off-line Analysis of Raw Signals
CSF Dynamics Tools
Cerebrovascular Reactivity Tools
Register New Key
Installed Monitor Modules
Simulator
3rd Party Plugins
Close

Appendix 4: Preconfigured users and passwords

Administrator – 2718

Manager – 1618

Operator – 3142

Nurse – 1414

The users, their passwords, and their rights are fully configurable in the software, using Users form. The default users have been chosen to fulfil the following roles:

User	Role
Administrator	Complete access to all the software configuration options, the users and passwords
Manager	Access to all the configuration options, except the users and password. This will normally be the user to do the entire configuration needed for data collection.
Operator	Control of the data collection process using preconfigured profiles, and changes to the charts layout and properties.
Nurse	Access to clinical annotations tools only. This should be normally set up as the default user kept logged-in during the data collection process, in order to prevent any inadvertent disruption to data recording but at the same time allowing and encouraging quick access to the clinical annotations.
Guest	This ‘user’ has no rights, making it impossible to interact with the software in any way.