ICM+ Standard of Procedures



INVOS monitor

28 April 2020

https://icmplus.neurosurg.cam.ac.uk

ICM+® is a registered trademark. Copyright © 2020 Cambridge Enterprise Limited All rights reserved

Table of Contents

Prerequisites	3
Locking and unlocking ICM+	5
Starting a new data collection session	7
Manually configuring data collection	9
Annotating clinical events	13
Terminating the data collection session and archiving the data	14
Restoring a closed data collection session	16
Appendix 1: Configuring ICM+ system options	17
Appendix 2: ICM+ configuration folders and files	22
Appendix 3: Editing ICM+ Projects	23
Appendix 4: Registering ICM+	26
Appendix 5: Preconfigured users and passwords	28
Appendix 6: Default configurations profiles	29
Appendix 7: Selected ICP monitoring references	31

Prerequisites

- 1. A laptop (or a PC) with the latest ICM+ and INVOS module installed
- 2. INVOS monitor



3. Appropriate cables:

Connection with ICM+ laptop is via port 1 (above) and a null modem Serial-USB cable, like this:

https://www.startech.com/uk/Cards-Adapters/Serial-Cards-Adapters/USB-to-Null-Modem-RS232-DB9-Serial-Adapter-Cable-DCE-FTDI~ICUSB232FTN



4. Make sure the Output format setting in INVOS monitor matches the setting of the ICM+ module:

Once the INVOS System components and the external device are connected, the INVOS Monitor is ON and in Run Function, press the HOME () key to display the Main Screen and follow these navigation bar options to begin interfacing:

BASELINE MENU	EVENT MARK	ALARM AUDIO ON/OFF	NEXT MENU
OUTPUT SELECT	USER CONFIGURATION	TIME SCALE	PREVIOUS MENU
USB	DIGITAL OUTPUT		PREVIOUS MENU
PC LINK	PHILIPS	PREVIOUS MENU	MAIN MENU
CASE HISTORY	OUTPUT FORMAT	PREVIOUS MENU	MAIN MENU
OUTPUT FORMAT 1	OUTPUT FORMAT 2		PREVIOUS MENU

Select OUTPUT FORMAT 1 or OUTPUT FORMAT 2.

ICM Module settings are defined in InvosModule.ini file:

ir	nvos		
	Share View		
	≪ Program Files (x86) → University of Cambridge → I	CM+ → Monitors → invos	✓ 🖸 Search ii
	Name	^	
	InvosModule.dll		
	🔝 InvosModule.ini		

Set the setting DigitalOutputFormat to match the number of the Output Format in INVOS setting above, eg:

DigitalOutputFormat=1

(Format 1 is the default setting in the ICM+ module)

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 (configured in the settings, figure below), ICM+ automatically switches to the default user, if configured, which for the data collection should be set to **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 main menu bar.



Or the speed tool bar, when the data collection is in progress



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

Current user: Default user:	Administrator Nurse			
Default	Lock	1	2	3
Other user		4	5	6
Name Adr	ninistrator 👻	7	8	9
Password ••	••		0	Back

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 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 entered:

	Traumatic Bra	in Injury		~	New Project	
ata File:	\\Mac\Home\Docume	\\Mac\Home\Documents\\CM+\Data\TBI_20200428161406_DRPETERSMEDB55.icmp				
Patient's	information					
First N	ame	Middle Initia	Date Of Birth	28/04/2020	00:00	
Surnar	me		Date Of Ictus	28/04/2020	♥ 00:00	
Hospit	al ID		Date Of Admission	28/04/2020	00:00	
Room/	Bed No		Sex	Unspecified	~	
Anonyr	mised ID					
Clinica	I background					
Clinica	I background					
Clinica	I background					
Clinica	I background					
Clinica	I background	raphics From	IntelliVue			
Clinica	I background Retrieve Demogr quisition/Analysis Co	raphics From	IntelliVue		~	
Clinica F Data Acc W:VCI	I background Retrieve Demogr quisition/Analysis Co M+\Configs\Testi	raphics From nfiguration Profile ng\Profile - Intellivue	IntelliVue e + INVOS.icmc			
Clinica F Data Acc W:VCI	I background Retrieve Demogr quisition/Analysis Co M+\Configs\Testi nise the profile	raphics From nfiguration Profile ng\Profile - Intellivue	IntelliVue e + INVOS.icmc) Line Analysis	✓ 😭 ·	
Clinica F Data Acc W:\ICI	I background Retrieve Demogr quisition/Analysis Co M+\Configs\Testi nise the profile	raphics From nfiguration Profile ng\Profile - Intellivue Q Clear All	IntelliVue e + INVOS.icmc Signals Sources	1 Line Analysis	V Clear History	

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 is performed using Device Check dialog.

Devices check			
Please check the	connections before continuing:		
Device	Connection	Test	Enabled
IntelliVue	COM2	1	Yes
INVOS	COM4	1	Yes

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.

If the 'Auto start recording at New Session' option is selected in the settings ICM+ connection to the monitor will be tested automatically and the dialog will close after the test. If the test initially fails different serial (COM) ports available in the computer should be tried and tested until the connection is established or all options are exhausted.

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:

Customise the profile	Clear All	Signals Sources	🔀 On Line Analysis
✓ ОК	X Cancel	ॐ On Screen Key⊧	

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

6	Hone Charts	Tagle	ICM	/+ - CTBI_CAM_20161223145142_HEX.icmp	
				🕨 📼 🚺	2
Lo	gin Minimise Signals Ca Ribbon	culations Connections Check	Save Load Profile Profile	Start Stop Monitor Data Ne Snapshot Ev	New New Event Note
	Ana	lysis Configuration	Profile	Control Panel A	Annotations

This brings up the Sampler Configuration form:

🙊 Sampler Configur	ation Dialog					- 0 ×
Digital output devices	Analogue output devices	RS232 ASCII stre	aming devices			
Name	Туре	Port	Baud	Sampl Frq	Enabled	
Modify	+ Add	Delete	lear			
Name	Units Device	Waveform	Min V Ma	x Enabled		

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.

Sigital Output Devic	e Configuratio	n Dialog		×
Device Name: INVOS	3	Device Type:	INVOS	\sim
			InfinityRS232 Intellivue INVOS ISCUS Licox Licox2 LifeSense Lucid	~
Interface type	COM Port: Baud Rate: Address:	COM1 ~ 9600 ~	Sampl. Freq. 1.00 💌 Enabled: 🗹	~
✓ ок 🗶	Cancel	☞ Keyboard		

When the correct interface module is chosen (INVOS), clicking on 'Communication Test' will try to establish communication with the monitor and the log of that communication is printed in the memo box, listing also all the parameters that are available to download from the monitor.

ligital Outpu	It Device Configuratio	on Dialog		×
Device Name:	INVOS	Device Type:	INVOS	~
Connection esta Numerics values Available waves Connection clos	blished s received /numerics list: rSO2_ ed	R,rS02_L		< >
Interface type	COM Port: Baud Rate: Address:	COM4 ~ 9600 ~	Sampl. Freq. 1.00 Fnabled:	
🗸 ок	X Cancel	☞ Keyboard		

When the connectivity is confirmed the dialog can now be closed, which causes the device to be added 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.

	ration Dialog				3 3	>
gital output devices	Analogue output	devices RS232 A	ASCII streaming d	levices		
Configured devices	with proprietary d	igital output protoco	ls			
Name	Туре	Port	Baud	Sampl Frq	Enabled	
INVOS	INVOS	COM4	9600	1.00	Y	
Modify	+ Add	- Delete	Clear			
onfigured modalities	to be collected					
Name	Jnits Devic	e Wavef	orm Min V	Max Enabl	ed	
Modify	+ Add	Delete	Clear			
Modify	+ <u>A</u> dd	<u>D</u> elete	Clear			

Digital Output Device Signals Selection Dialog	×
Device : INVOS ~	
Signal Name :	
Signal Units :	
Waveform :	
Enabled 🗹	
Physiological Values Range	
Min Value : 0	-
Max Value : 300 Start Stop	
VOK X Cancel	

This opens a signal selection dialog:

Using the little '...' button one can select available signal, one at a time

_		1
Digital Output Device Signals Sele	ection Dialog	×
	Signal selection dialog \times	
Device : INVOS	List of available signals	
Signal Name :	rS02_R rS02_L	
Signal Units :		
Waveform :		
Enabled 🗹		
Physiological Values Range		
Min Value : 0		
Max Value : 300	C Refresh the list	Stop
✓ OK X Cancel	V OK X Cancel	

When a parameter is selected one can test if the data is coming in as expected by using the Start button.

Digital Output Device Signals Selection	on Dialog	×
Device : INVOS Signal Name : IrSO2_L Signal Units : IrSO2_L Waveform : IrSO2_L Enabled Physiological Values Range	Preview 65 64.5 64 63.5 63 62.5 63 62.5 63	
Min Value : 0 Max Value : 300	Start Stop	
VOK X Cancel	>> Keyboard	

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

ital output devices	Analog	ue output device	RS232 ASC	Il streaming	devices			
onfigured devices	with prop	prietary digital ou	tput protocols					
Name	Туре	Po	rt	Baud	Sampl Fro	e Enab	led	
IntelliVue	IntelliV	ue CC	DM18	115200	200	Y		
INVOS	INVOS	6 CC	DM21	9600	1	Y		
Modify	+	Add –	Delete	🔇 Clea <u>r</u>]			
onfigured modalitie	es to be c	ollected						
Name	Units	Device	Waveform	Min V	Max	Enabled		
icp	mmHg	IntelliVue	ICP	0	100	Y		
	mmHg	IntelliVue	ABP	0	200	Y		
abp	mmlia	IntelliVue	П	0	200	Y		
abp ecg	mmng				200	V		
abp ecg rso2	mmng	INVOS	rS02_L	0	300			
abp ecg rso2	+	INVOS	rS02_L	0]			

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.

		on blaidig					
rtual Signals	Primary Analysis	Secondary Analysis	1 Final Analysis				
Name	Formula	Sampling Frq	Min	Max	Digital Filter	Enabled	
ABP	abp	100	0	300	None	Y	
ICP	icp	100	-30	98	None	Y	
rSO2	rso2	1	0	100	None	Y	
Mod	ify <mark>+</mark> <u>A</u> dd	I <u>D</u> elete	Clear	Auto <u>F</u>	jill Default	Fs [Hz]: 200	.0

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. Patient discharge/stop data collection session
- 3. Event annotation form (which will be disabled if no events are configured)
- 4. Free textual annotations form
- 5. An on-screen keyboard
- 6. The last button closes this tool bar and unfolds the main menu toolbars

Terminating the data collection session and archiving 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:

🔵 Data archiving configura	ation form	- • X
Use settings from the proje	ct: Devel 🔻	
Data storage details		
Data Archive Folder		
//srv1/backup		
Create New Subfol	der 📝 Use original file name for the subfolder	
devel_CAM_20161103	3212242_HEX	100
Create info text file	<u>.</u>	
	Move	
🗸 ОК 🔀 Са	nce Remember Selection	

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.

R	File Open Dialog	1				×
Type 😹 😹 🍸 🛛 ICM+ main data file 🗸 🗸	C:\Users\Manuel\Documents\ICM+\Data				~	35
Browse for File						
Documents Documents	Name CTBL20150106153922_MANUELPC.lcmp CTBL20150106142213_MANUELPC.lcmp CTBL201422154210_MANUELPC.lcmp CTBL20141227154210_MANUELPC.lcmp CTBL20141202161420_MANUELPC.lcmp generic_20141202161420_MANUELPC.lcmp ABP/CP.LCPC.bF-Hemedex_TBL20mp ABP/CP.CPCBF-Hemedex_TBL20mp	Size 40 KB 30 KB 1,314 KB 25 KB 73 KB 47 KB 838 KB 179 KB	Item type ICM+ data file ICM+ data file	Date modified 07/01/2015 00 26:47 06/01/2015 00 26:47 27/12/2014 19:25:08 27/12/2014 19:25:08 27/12/2014 19:25:09 10/11/2014 12:23:01 10/11/2014 09:47:30		
League of Legend: C:\Users\Manuel\Documents\ICM+\Data\CTBL 2015	0106153922 MANUELPC.icmp					
Events, Size: 4706 Notebook, Size: 0 Generalin(s, Size: 366 Clinica0das, Size: 2 Patient/Descr, Size: 780 P.RawData Patient/Descr, 2						< >
Name= MidInitial= Surname= HospitalNo= AnonymizedID=123 DateOfBirth=06/01/2015 Sex=Male		ſ				

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.

Appendix 1: Configuring ICM+ system options

Most of the programmable behaviours of the software can adjusted via the Settings menu. This menu can be found by clicking the Home tab and the Settings button.



In the Settings menu you will need to configure several things:

• On the General tab:

			Settings		
Seneral	Archiving	Display	Analysis	Raw Data Rec	System
Resear	ch Group/Ce	entre ident	tificator		
CAMB	RIDGE				
System	Configuratio	n Folder			1000
C:\Use	rs\Public\Doc	uments\K	CM+\sysco	nfig\	Es
User Pk	igins Folder				
C:\Use	rs\Public\Doc	uments\K	CM+\Plugins	A	E
Default	Configuratio	n Profiles	Folder		
C:\Use	rsManuelDo	cuments	ICM+\Confi	gsl	E
Default	Data Folder	3			
C:\Use	rs\ManuelDo	cuments\	ICM+\Data\		6
Data Ed	a Nama Form				
Data 1 a			010.010	0.175 THE	100
Remov	e records w	th NAN vi	alues while	exporting to text	fie [

- The Research Group/Centre identification will be a unique name in the project that will identify the centre. This name should be fully inserted in capitals (ex. CAMBRIDGE).
- The Data File Name Format will be used to configure the structure to be used on the construction of the name of each data file. As each file generated in the study must have a unique identifier we agreed in using a structure that uses the format highlighted in the picture. A description on how to build this File Name format is presented further down in this appendix.

• On the Archiving tab:

		1	Settings			*
General	Archiving	Display	Analysis	Raw Data Re	c System	1
Local an	chiving					
Automat	ic Data Arch	iving at the	e recording	session end:	Ask	~
Create t	ext info files	for archiv	ed data		i.	7
Delete o	riginal data a	after archiv	vina		F	~
Archive	Root Folder	Location				and .
						Es:
Archive	Folder Name	Format				
<proje< td=""><td>CT>_<cent< td=""><td>RE>_<ano< td=""><td>NYMD>_</td><td>DATE><time></time></td><td></td><td>1</td></ano<></td></cent<></td></proje<>	CT>_ <cent< td=""><td>RE>_<ano< td=""><td>NYMD>_</td><td>DATE><time></time></td><td></td><td>1</td></ano<></td></cent<>	RE>_ <ano< td=""><td>NYMD>_</td><td>DATE><time></time></td><td></td><td>1</td></ano<>	NYMD>_	DATE> <time></time>		1
					_	不
Upload t	o a remote d	lestination				
Defe a	Destination	COT NO			-	
Detaut	Jestination:	CEN	ERIDI		*	1
			0-			

- The Archive Folder Name Format will follow the same structure as the Data File Name Format. This setting is used for organising local archival storage of the data files.
- The remote server Upload (accessible via the upload function) default Destination can be selected here but it is the matching setting in the Project configuration that will ultimately take precedence.

• On the Raw Data Rec tab:



 The Use 'Start' button to control Raw Signals Recording must be checked if you are using ICM+ to record any data directly from bed side monitors • On the System tab:

Settings	×
General Archiving Display Analysis Raw	Data Rec System
Auto restore session in progress on startup	Enable 🗸
Auto restart recording at program startup	Enable 🗸
Inactivity time to software auto logout [min]	0
Auto unlock program as user :	Nurse 🗸
Operating System Policy	
Use this program instead of Windows shell	Disable v
Disable logoff/shutdown	Disable 🗸 🗸
Disable Task Manager	Disable 🗸 🗸
Disable locking the computer	Disable v
Disable Windows password change	Disable v
Windows Auto Login	
State Disable v Password	
User Confirm	
Patient description encryption Passphrase	
✓ OK X Cancel 🛞 Keyb	oard

 Set the Auto unlock program as user to Nurse. Setting the inactivity time to a value greater than 0, eg 10 min, will cause the software to auto login as that default user following a selected period of time without interaction with the software (this will only happen of course if the program was unlocked as another user) To build the **Data File Name Format** you will need to click the highlighted button and the following form will appear:

<project></project>	<centre></centre>	
<date> <time></time></date>	<anonymid></anonymid>	Free Tex
<firstname> <lastname></lastname></firstname>	-DATE>	Please prov
<computer> <bedid></bedid></computer>	<time></time>	CTBI_
<patientid> <anonymid></anonymid></patientid>		
<guid></guid>		
Name Sample		
CTBI Cambridge C	AM1234 20150105124302	



In this form it is possible to add/remove any name element present in the Available Elements menu.

The '_' and any additional static text can be inserted by using the element '<text>' and inserting the text to be added manually.

Appendix 2: 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 3_{rd} 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 3: 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.

Project Manager	nent			×
New	Name	Abbreviation	Description	
<u>C</u> opy	CENTER-TBI	СТВІ		
<u> </u>	ICP monitoring Traumatic Brain Injury	ICP TBI		
Export				
🗸 ок				

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

Project Configuration ×							
General	Seneral Data Fields Events Data Archiving						
Proje	Project Definition						
Nan	ne:	Ī	CP monitoring	Abbreviation:	ICP		
Description:							
Cus	tom Module:					*	
Data	a Folder:		\Mac\Home\Documents\ICM+\Data			P	
Con	fig Folder:	ľ	\Mac\Home\Documents\ICM+\Configs			P	
Data	Data File Name Format:		<project>_<date><time>_<computer></computer></time></date></project>			0444 	
Defa	ault config pro	ofiles:	CereLink ICP.icmc			E.	
	Enforce default configuration profiles						
V OK Keyboard							

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. **'Config Folder'** is a folder (could be a network share) where the data configuration profiles are kept

4. **Data File Name Format** lists elements that will be used to create automatic file names for each new data acquisition sessions.

5. **Default config profiles** lists profiles that will be available to select in the new data acquisition forms.

eral Data Fie	lds Events Data	Archiving			
ata Fields Defi	nitions				
	Name	Caption	Туре	Description	
🕂 Add	GCS	GCS	Category	Glasgow Coma Score at admission	٦
🜱 Edit	СТ	CT Marshall score	Category	CT Marshall score at admission	
X Remove	ТуреТВІ	Type of TBI	Category	General type of brain trauma	
Move Up	Politrauma	Politrauma	Category	Other significant injury	
👆 Move Dn					

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.

Project Configuration					
Use Custom Events Form: Custom Event Groups Complications CTBI CTBI CTBI CTBI CTBI CTBI CTBI CTBI	IF Form: CENTER-TBI All selected (checked) events All selected (checked) events VasoprDown (vasopress/Inotropes DOWN) CTBI Vusopritive (vasopress/Inotropes DOWN) CTBI Suction CTBI Physio (Physio/movement) CTBI SedDown (Sedation DOWN) CTBI SedDown (Sedation Bolus) CTBI				
* 🔟 + 🔌 🗙 🗹 🗇					
V CK Strangel Strange					

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 there is also an option of using a customised event form (designed for CENTER-TBI project), 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.

Project Configuration
General Data Fields Events Data Archiving
Show data packaging prompt at the recording session end
Data Archive Folder
\\fileserver\archive
Create New Subfolder Use original file name for the subfolder
Reset to defaults
Remote upload server
Default Destination:
Data Snapshots
Show data snapshots reminders
Snapshot length [minutes] 60
List of timepoints for data snapshots [hours]
VK Keyboard

Here one can define the location and type of data archive procedure:

- This should be ticked in order for you to be prompted to convert the file to archiving HDF5 format at the end of the recording session
- 2. Location of a local file server for data archiving,
- the destination of a remote SFTP upload data server , configured in the Settings, and facilitating multicentre data collection projects

Appendix 4: 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.

Detailed ICM+ License Info			x
ICM+ Registration Status	4	3rd Party Plugins	
Unregistered			
Simulator			
Pressio Pressio2			
Qose			

This will bring forth the ICM+ Registration Form.

InstallCode:	Please quote this code for any further assistance 905 F4BC6C299
Username:	peter
Institution:	University of Cambridge
Computer:	HEX Copy Details Email Details
Register No Please enter the	שנ registration key, then press the [Register] button

Using Copy Details button one can then copy the registration details to paste into an email and send to <u>ps10011@cam.ac.uk</u> with a request to generate a key. The Email Details is a shortcut for this when the computer is networked.

Once the key is received it needs to be pasted into the highlighted space and Register now button clicked upon which the registration successful dialogue should appear.



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

ICM+ Registration Status		4	3rd Party Plugins
Registered To: peter			
Institution: University of Cambridge	_		
Registration Valid Until : 18/04/2018			
Registered Features	_		
Data Acquisition And Real-time Analysis	V		
Customisable Analysis Configuration	V		
Raw Signals Recording	V		
Off-line Analysis of Raw Signals	V		
CSF Dynamics Tools	V		
Cerebrovascular Reactivity Tools	V		
🔒 Register New Key			
Installed Monitor Modules			
Simulator			
Pressio			
Pressio2			

INVOS data collection ICM+ SOP

Appendix 5: 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.

Appendix 6: Default configurations profiles

At the ICM+ installation time there are a set of configuration profiles provided. The profiles contain configuration of calculations performed on collected waveforms of ICP, and temperature (when fed via the patient monitor – no direct output of this modality from CereLink). All the parameters are calculated once every 10sec, or once every 60sec, depending on the profile. The display of these parameters is organised into several pages, which can navigated using a set of tabs organised vertically on the left side of the charts.



The pages above have been configured to show:

Tab	Content
Main page	Trends of the mean values of the measured parameters ICP and temperature, and the amplitude of the ICP pulse wave
Pulse wave	Shows parameters derived from the analysis of the ICP pulse wave
AMP/P	Shows the ICP mean pressure – amplitude relationship, which reflects the pressure/volume curve of the brain
Slow waves	Shows parameters derived from the analysis of the slow waves of ICP
Resp waves	Shows parameters derived from analysis of the respiratory component of ICP waves
Histograms	Presents mean ICP and the ICP pulse amplitude in the form of histograms summarising amount of time spent in critical regions (>20mmHg for ICP), as well as the dose of ICP (above the 20mmHg threshold) over the time period depicted (which can be changed by clicking on the time scale)

The following table contains explanation of all the parameters configured.

Parameter	Units	Description
ICP	mmHg	Intracranial pressure
AMP	mmHg	Amplitude of the fundamental harmonic of ICP pulse wave
HR	1/min	Heart (pulse) rate
RR	1/min	Respiratory rate
RAP		Brain compliance index
RA	mmHg	Amplitude of respiratory waves (fundamental harmonic)
ICPmax	mmHg	Maximum value of mean ICP over the calculation period
ICPmin	mmHg	Minimum value of mean ICP over the calculation period
Slow	mmHg	Equivalent amplitude of slow ICP waves (square root of power)
ICPsys	mmHg	Systolic ICP
ICPdia	mmHg	Diastolic ICP
ICPpulse	mmHg	ICP pulse amplitude
TEMP	Grad	Temperature

Appendix 7: Selected ICP monitoring references

- Czosnyka ZH, Sinha R, Morgan JA, Wawrzynski JR, Price SJ, Garnett M, Pickard JD, Czosnyka M. Shunt Testing In Vivo: Observational Study of Problems with Ventricular Catheter. Acta Neurochir Suppl. 2016;122:353-6.
- 2: Czosnyka Z, Czosnyka M, Pickard JD, Chari A. Who Needs a Revision? 20 Years of Cambridge Shunt Lab. Acta Neurochir Suppl. 2016;122:347-51.
- 3: Kasprowicz M, Lalou DA, Czosnyka M, Garnett M, Czosnyka Z. Intracranial pressure, its components and cerebrospinal fluid pressure-volume compensation. Acta Neurol Scand. 2016 Sep;134(3):168-80. Review.
- 4: Varsos GV, Werndle MC, Czosnyka ZH, Smielewski P, Kolias AG, Phang I, Saadoun S, Bell BA, Zoumprouli A, Papadopoulos MC, Czosnyka M. Intraspinal pressure and spinal cord perfusion pressure after spinal cord injury: an observational study. J Neurosurg Spine. 2015 Aug 14:1-9. [Epub ahead of print] PubMed PMID: 26273764.
- Kim DJ, Kim H, Kim YT, Yoon BC, Czosnyka Z, Park KW, Czosnyka M. Thresholds of resistance to CSF outflow in predicting shunt responsiveness. Neurol Res. 2015 Apr;37(4):332-40.
- 6: Lazaridis C, DeSantis SM, Smielewski P, Menon DK, Hutchinson P, Pickard JD, Czosnyka M. Patient-specific thresholds of intracranial pressure in severe traumatic brain injury. J Neurosurg. 2014 Apr;120(4):893-900.
- 7: Chari A, Czosnyka M, Richards HK, Pickard JD, Czosnyka ZH. Hydrocephalus shunt technology: 20 years of experience from the Cambridge Shunt Evaluation Laboratory. J Neurosurg. 2014 Mar;120(3):697-707.
- Werndle MC, Saadoun S, Phang I, Czosnyka M, Varsos GV, Czosnyka ZH, Smielewski P, Jamous A, Bell BA, Zoumprouli A, Papadopoulos MC. Monitoring of spinal cord perfusion pressure in acute spinal cord injury: initial findings of the injured spinal cord pressure evaluation study. Crit Care Med. 2014 Mar;42(3):646-55.
- Hart MG, Czosnyka M, Czosnyka ZH, Fernandes HM. Combined intracranial pressure monitoring and cerebrospinal fluid infusion study to guide management of slit ventricle syndrome. Pediatr Neurosurg. 2013;49(2):113-8.
- Smielewski P, Czosnyka Z, Kasprowicz M, Pickard JD, Czosnyka M. ICM+: a versatile software for assessment of CSF dynamics. Acta Neurochir Suppl. 2012;114:75-9.
- Weerakkody RA, Czosnyka M, Schuhmann MU, Schmidt E, Keong N, Santarius T, Pickard JD, Czosnyka Z. Clinical assessment of cerebrospinal fluid dynamics in hydrocephalus. Guide to interpretation based on observational study. Acta Neurol Scand. 2011 Aug;124(2):85-98.
- Kim DJ, Carrera E, Czosnyka M, Keong N, Smielewski P, Balédent O, Sutcliffe MP, Pickard JD, Czosnyka Z. Cerebrospinal compensation of pulsating cerebral blood volume in hydrocephalus. Neurol Res. 2010 Jul;32(6):587-92.
- 13: Carrera E, Kim DJ, Castellani G, Zweifel C, Czosnyka Z, Kasparowicz M, Smielewski P, Pickard JD, Czosnyka M. What shapes pulse amplitude of intracranial pressure? J Neurotrauma. 2010 Feb;27(2):317-24.
- 14: Kim DJ, Czosnyka Z, Keong N, Radolovich DK, Smielewski P, Sutcliffe MP, Pickard JD, Czosnyka M. Index of cerebrospinal compensatory reserve in hydrocephalus. Neurosurgery. 2009 Mar;64(3):494-501; discussion 501-2.
- Smielewski P, Lavinio A, Timofeev I, Radolovich D, Perkes I, Pickard JD, Czosnyka M. ICM+, a flexible platform for investigations of cerebrospinal dynamics in clinical practice. Acta Neurochir Suppl. 2008;102:145-51.
- Czosnyka Z, Keong N, Kim DJ, Radolovich D, Smielewski P, Lavinio A, Schmidt EA, Momjian S, Owler B, Pickard JD, Czosnyka M. Pulse amplitude of intracranial pressure waveform in hydrocephalus. Acta Neurochir Suppl. 2008;102:137-40.
- 17: Czosnyka M, Smielewski P, Lavinio A, Czosnyka Z, Pickard JD. A synopsis of brain pressures: which? when? are they all useful? Neurol Res. 2007 Oct;29(7):672-9.
- 18: Czosnyka M, Smielewski P, Timofeev I, Lavinio A, Guazzo E, Hutchinson P, Pickard JD. Intracranial pressure: more than a number. Neurosurg Focus. 2007 May 15;22(5):E10.
- Czosnyka M, Czosnyka Z, Keong N, Lavinio A, Smielewski P, Momjian S, Schmidt EA, Petrella G, Owler B, Pickard JD. Pulse pressure waveform in hydrocephalus: what it is and what it isn't. Neurosurg Focus. 2007 Apr 15;22(4):E2.