User manual

# Neuro-MS.NET (ver. 2)

Software

# Contents

# Attention!

> **If you purchased computer separately, install the Neuro-MS.NET software before starting to work!**

If you will work with program using touchscreen, it is necessary to calibrate it (see the touchscreen user manual).

Before the first exam you must execute the menu command **Setup|Change** and on the *"Hardware"* page check whether the power frequency corresponds to that of your region (for Russian Federation – 50 Hz).

> **If main window menu is hidden, click on application main window icon.**

If activation (i.e. the file with license key) is needed while working with the magnetic stimulator, it is necessary to contact your dealer or **Neurosoft** Company and provide them with the magnetic stimulator serial number to get the license key. This file can be saved either in work directory of the program or in root directory of any computer disc. You can install the program and license key on any number of computers without restrictions. If the magnetic stimulator has been changed, a new activation (i.e. a new file with license key) will be necessary. In case several **Neurosoft** devices are used on one computer, you will need several files with license key as well (one file for one device).

> **Do not start working with magnetic stimulator before you have read the user manual!**

# Introduction

**Neurosoft** Ltd modifies constantly the manufactured devices and software for them. Thus the software can differ from this one described in this manual. The last version of the user manual is provided on the compact disk supplied with the device.

The user manual is delivered together with **Neuro-MS.NET** software and the magnetic stimulator of **Neuro-MS/D** series manufactured by **Neurosoft** Ltd.

To obtain the motor threshold, it is required to purchase the digital EMG and EP system manufactured by **Neurosoft** Ltd.

We hope that our devices will increase the diagnostic opportunities and prestige of your clinics and you will enjoy while operating on them.

You can send your responses and recommendations to the following address:

**Post Office Box 10, Ivanovo, 153000, Russia**

or by e-mail:

**help@neurosoft.ru**

You can find additional information on **Neurosoft** products on our website:

**www.neurosoft.ru**

or ask questions by phone:

**+7 (4932) 24-04-37 (Service Department)**

**+ 7 (4932) 24-04-34 (Commercial Department)**

# Basic Notions

**Medical protocol** — the documented plan of desease detection, diagnose and treatment. Protocols are created on the basis of medical practice, collective experience and outcomes evaluation. Medical protocols are used by medical personnel as guides in order to avoid inefficient methods of treatment. Those methods vary according to professional opinion and experience of the doctors. Medical protocol for magnetic stimulation contains necessary and sufficient information for treatment course administration.

**Motor evoked potential (MEP)** — the compound muscle action potential recorded from the muscle while stimulating the certain part of central nervous system by single pulse. Normally, it represents the double-humped trace: the first phase is negative (upward), the second one is positive (downward).

**MT (motor threshold)** — the minimal stimulus value required to evoke the motor evoked potential.

**Stimulation site** — the definite body area affected by the magnetic field.

**Recording site** — a part of body for motor threshold acquisition.

Magnetic stimulator can generate following types of stimuli:

- **Monophasic stimulus** — stimulus where current in the coil flows in one direction increasing sinusoidally and decreasing exponentially (Fig. 1). This type of stimulation is available only on **Neuro-MS/D** magnetic stimulator with the expansion unit.
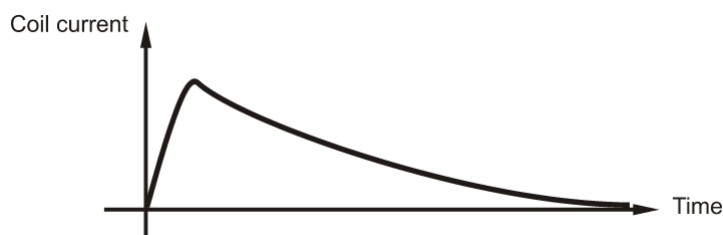


Fig. 1. The monophasic waveform.

- *Biphasic stimulus* — stimulus where current waveform in the coil is characterized by one period of damping sinusoid (Fig. 2). This is the standard stimulation type provided on any magnetic stimulator manufactured by **Neurosoft** Ltd.

Coil current

Time
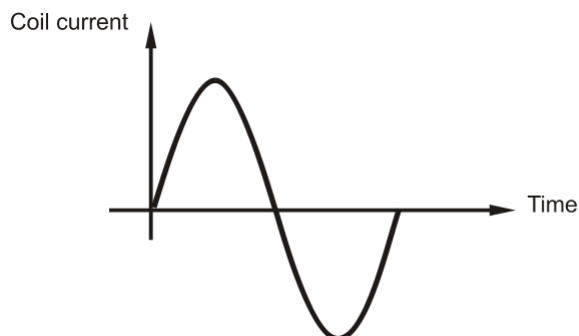
Fig. 2. The biphasic waveform.

- *Biphasic burst stimulus* (only when the stimulator is controlled via computer) – the biphasic stimulation when the series of the biphasic pulses with high frequency (up to 100 Hz) and decreasing amplitude are generated instead of single pulse (Fig. 3). The amplitude of the first pulse is specified for this stimulus. After delivering the first stimulus the residual charge of the capacitor is used to generate the next stimulus.

Coil current

Time

Fig. 3. The biphasic burst waveform.

**Train (pulse series)** — the definite number of pulses generated by the magnetic stimulator with the specified frequency and amplitude.

**Stimulation subprogram** — set of pulse series (trains) and pauses characterized by (Fig. 4):

- order number (1);

- stimulation type (2);

- stimulation amplitude (intensity) (3);

- number of pulses or bursts in train (4, 4a);

- pulses or bursts frequency in train (5, 5a);

- total number of trains (6);

- pause between trains (7);

- number and frequency of pulses in burst (during the stimulation of "burst" type) (8 and 9 respectively);

- time to the next stimulation subprogram (10);

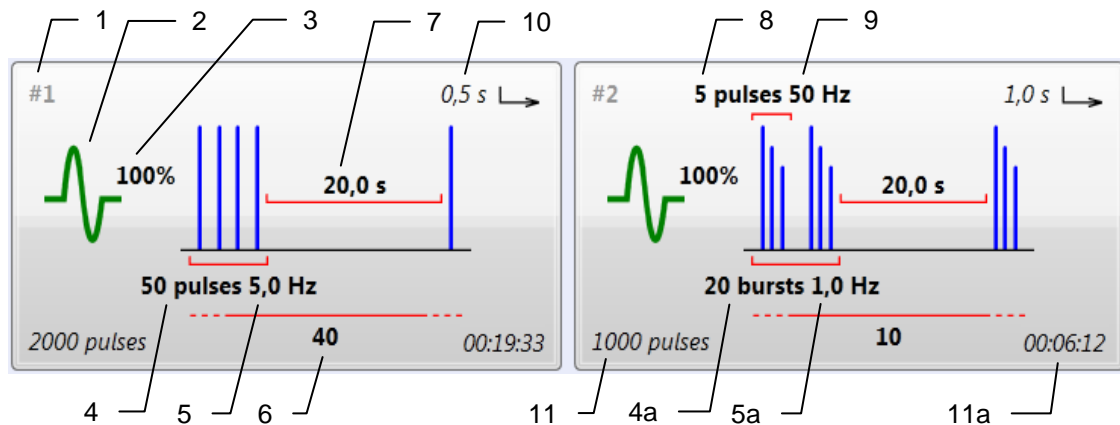- duration (in pulses (11), in hh:mm:ss (11a)).



Fig. 4. Stimulation subprograms.

**Stimulation program** — the series of pulses (trains) and pauses prescribed by a doctor for the concrete stimulation point. The stimulation program can consist either of one subprogram (simple stimulation program) or several subprograms (complex stimulation program).

**Treatment session** — the base unit of the treatment course. As a rule, one treatment session is equal to one visit to a doctor. The treatment session consists of the stimulation programs.

**Treatment course** — the set of treatment sessions prescribed for a patient by a doctor.

**Stimulation program and treatment course templates** — data structures to create stimulation programs and treatment courses respectively.

> **Practically treatment course template is medical protocol.**

# 1.   Quick Start

In this chapter you can find brief instructions which describe the standard treatment procedure performed with the use of **Neuro-MS.NET**.

1.  Connect the required coil to the magnetic stimulator. Make sure that power connector is inserted firmly and the spring-lock is locked.

2.  Connect the magnetic stimulator to the power supply (~220B) and to the computer USB port. Switch on the magnetic stimulator using "Mains power" switch on the back panel by setting it to "I" position. "Power state" indicator will be highlighted yellow.

3.  If you will use digital EMG and EP system connect it to the computer USB port.

4.  Run **Neuro-MS.NET** (see "Neuro-MS.NET Run" chapter).

5.  In the program main window press "New treatment" button  on the toolbar or use **Treatment|New…** (**[Ctrl+N]**) main menu command.

6.  In the window that appears enter the patient's data (see "The Very Beginning: New Treatment" chapter). If you will use standard treatment template (scenario) choose the appropriate template in "Template" menu. You can find the detailed description of templates in "Treatment Templates" chapter. Press  button.

7.  If you didn't choose treatment template at the beginning of the treatment, the program would display "Stimulation algorithms" tab and ask you to form the treatment structure manually. You can find the detailed description of stimulation algorithm creating in "Treatment Algorithm" chapter.

8.  On "Single pulse mode (MT)" tab obtain the motor threshold using stimulation (button ) and fix amplitude value on the definite body areas (button ). You can find more information in "Single Pulse Mode (MT)" chapter.

9.  Switch to the "Repetitive (session) mode" tab. Perform the repetitive stimulation session according to the algorithm using "Start" , "Pause"  and "Stop"  buttons. To replace the coil use **Hardware|Coil replacement** menu command or corresponding  toolbar button. You can find more information in the "Repetitive (session) Mode" chapter.

10. To find more informanion about printing the treatment report read "How to Print the Treatment Report" chapter.

11. To complete (close) the treatment use **Treatment|Close** menu command or  toolbar button.

12. To close the program use menu command **Treatment|Exit** (**[Alt+X]**) or  toolbar button.

You can find more information about functions and capabilities of **Neuro-MS.NET** in following chapters of the manual.

# 2.   Work with Program

## 2.1. General Requirements

**Neuro-MS.NET** software is intended to control magnetic stimulator of **Neuro-MS/D** series manufactured by **Neurosoft** Ltd using the computer.

**Neuro-MS.NET** can control both magnetic stimulator of **Neuro-MS/D** series and digital EMG and EP systems manufactured by **Neurosoft** Ltd.

You can find information on how to work with digital EMG and EP systems manufactured by **Neurosoft** Ltd in corresponding technical manuals.

In this chapter you can find detailed instructions which will help you to work with program.

Most of high frequency actions in the program can be carried out in several ways. For instance, to start single pulse stimulation in the "Single pulse mode (MT)" page you can use:

- **Stimulation|Stimulus** menu command (you can choose the command using mouse (clicking the left button) or keyboard (**[Alt]** to open the menu, arrow keys to navigate through the menu and **[Enter]** to select the item));

-  "Stimulus" button at the bottom of the screen (place the mouse cursor on the button and click the mouse left button). If you use touchscreen use your finger instead of mouse;

- "Stimulus"button  on the coil;

- left pedal of the footswitch unit if you use it;

- "▪" button  on the amplifier front panel if you use digital EMG and EP system with keyboard;

-  button of the functional Bluetooth keyboard if you use it.

If you use digital EMG and EP system to detect MT, remember that active electrode should be connected to the negative terminal (usually black) on the amplifier and reference electrode should be connected to the positive terminal (usually red). Do not

forget to attach ground (general) electrode on the patient (the terminal of the ground electrode on the amplifier is usually green). If you won't use ground electrode, noise level could be extremely high and it will be difficult to receive signal of high quality.

## 2.2. Scale and Touch-style

**Neuro-MS.NET** interface provides an opportunity to use touch input (i.e. touching the monitor screen with the finger). Program provides:

- An opportunity to use special style (Touch-style) to display main application windows. To activate or to deactivate Touch-style use **Setup|Use Touchscreen style** menu command**.** Touch-style is active by default.

- An opportunity to set the appropriate scale for all interface elements. To change the scale use **Setup|Scale…** menu command and choose the appropriate scale value. Default scale value is "1.3".

> **If you use Touch-style use the main application window icon to show or to hide menu (Fig. 5).**
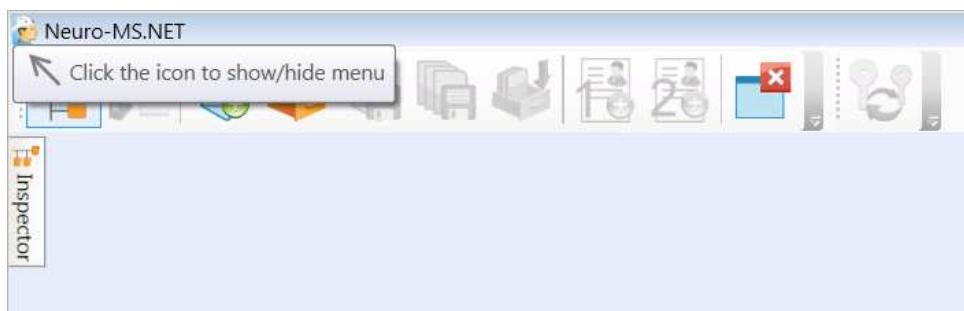


Fig. 5. The show/hide menu icon.

## 2.3. Software Setup. Computer Requirements.

If you purchase the Neuro-MS system together with the computer, it is delivered with installed and configured software. If you purchase the Neuro-MS system separately, please study carefully the following paragraphs.

**Neuro-MS.NET** software can run properly on any computer with the Intel Celeron 2.4 GHz processor (Intel Pentium Core 2 Duo is recommended) and higher, with not less than 2 Gb memory, and Windows XP (SP3 and above), Windows Vista (SP1 and above), Windows 7 operating systems. For software setup there should be 1 Gb of free hard disk space and 1 Gb of free hard disk space for the patient database.

**Neuro-MS.NET** interfsace provide an opportunity to use touch input (i.e. by touching the monitor screen with the finger). To facilitate text entry using virtual keyboard it is recommended to work on computer with Windows 7 operating system.

All the data of treatments performed with the use of the program are saved on the hard disk in a database common for all **Neurosoft Company** systems.

The software is delivered on a compact disk (CD). The installation process is executed in the following order:

Log in the system as administrator.

Insert the compact disk to the disk drive and wait the installation program to start (Fig. 6). If the autorun hasn't started and the window hasn't appeared (Fig. 6), find AUTORUN.EXE file on the CD and run it.
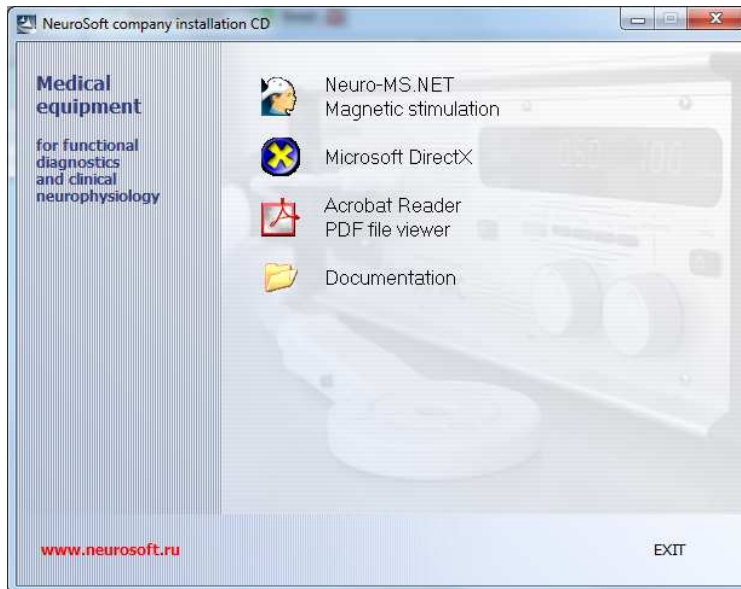


Fig. 6. The window of program installation run.

Point the mouse cursor at **Neuro-MS.NET** line and click the mouse left button. Follow the installation instructions. If you have no Internet connection, ignore program attempts to download updating files. The program procedes installation after several failed attempts.

To set up the program and hardware run the program (see the next chapter) and choose **Setup|Change** menu command. You can find more information in the "Hardware and Sorftware Configuration Settings" chapter.

## 2.4. Neuro-MS.NET Run

To run **Neuro-MS.NET** program, click "Start" button and choose **All programs|Neurosoft|Neuro-MS.NET|Neuro-MS.NET** menu command or click twice on

program icon  on the desktop.

## 2.5. General Principles

"Neuro-MS.NET" works under Windows operating system and comply with Windows software requirements. If you have worked with Windows programs, for example Mi-

crosoft Word, you would grip with **Neuro-MS.NET**. If you have not work with Windows operating system, you should learn basic Windows concepts.

When you run the program, the main window will be displayed (Fig. 7). At the top of the screen you can find **Treatment, Hardware, Report** etc. menu items. Below the menu you can find toolbar with tool buttons. You can press any button using mouse.

> **If Neuro-MS.NET use Touch-style (see "Scale and Touch-style" chapter), then after program running the main menu would be hidden. To show or to hide menu, click on main application window icon (Fig. 7).**
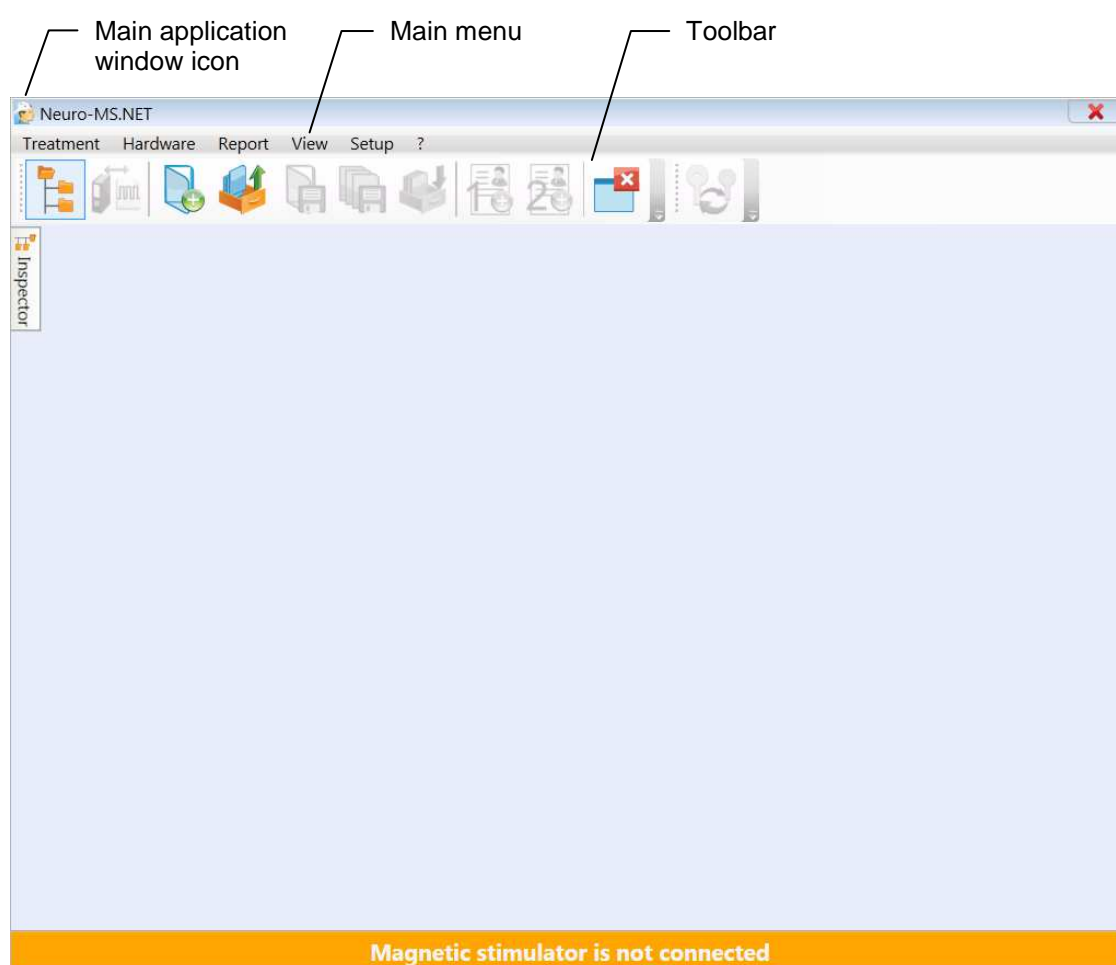


Fig. 7. Neuro-MS.NET main window.

The program control is operated with the help of a menu. Most frequently used menu items are also represented by buttons on the toolbar.

Toolbars can be placed in the top, bottom or on the side of the window (Fig. 8). . To place a toolbar, move the panel with the mouse cursor by the drag marker and drag it to a new place. To show or hide the panels or set their view (button size, signature, visibility and sequence, hotkeys and etc.), click the right mouse button on the panels and select the menu item **Setup…** from the context menu. You can find more information in "Toolbar" chapter.

Fig. 8. Toolbar arrangement.

All the data are saved in the database (card-file system). During the first start the database is created automatically in *C:\cardbaseMdb* directory on a computer hard disk. In future, you will be able to create new and connect any available databases created by *.NET*-programs produced by **Neurosoft** Company. For database description such terms as *card-file, patient card* and *treatment* are used.

*"*Treatment" in **Neuro-MS.NET** program refers to a collection of data, obtained during a medical treatment using magnetic stimulator produced by **Neurosoft** Ltd.

Treatments are saved in a patient card.

*"*Patient card" contains basic patient data (surname, name, date of birth etc.) and may include any number of treatments and exams, carried out at different times by any Neurosoft devices.

Patient cards are saved in card-files.

"Card-file" is a pool of any quantity of patient cards. Each card-file has a unique name and may contain, besides patient cards, nested card-files. Cards can be combined into card-file by any feature. Well-engineered card-file system will help you to put into order all stored information and to speed up access to it.

Experienced user should know that card-file system (database) represents several files saved in a directory (folder) on a computer hard drive. If it is necessary, you can create several data-bases on a computer hard disk (see more details below).

## 2.6. The Very Beginning: New Treatment

To start a new treatment use menu command **Treatment|New ([Ctrl+N])** or press [icon] toolbar button.
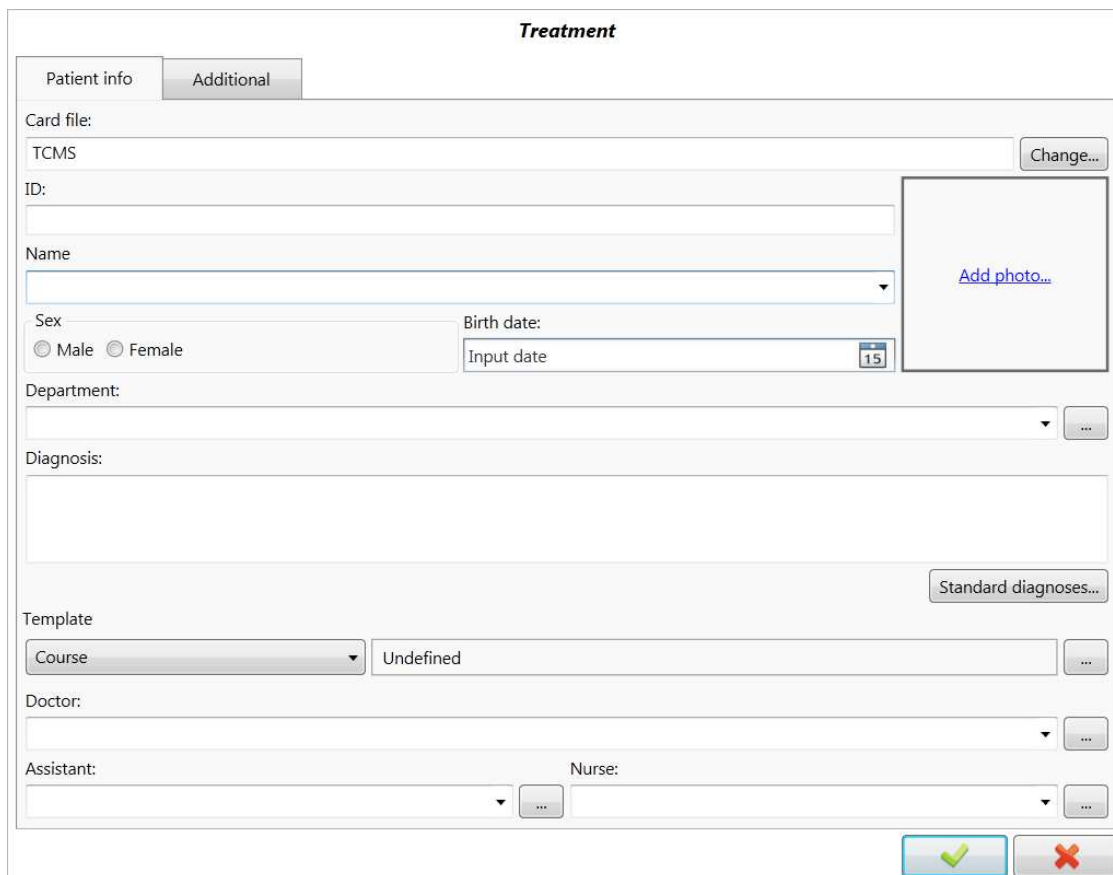


Fig. 9. The new treatment window.

In the appeared "Treatment" dialog box (Fig. 9) enter patient's data (optional):

- enter the patient's name;

- choose the patient sex;

- Enter the patient's date of birth by pressing numeric keys separated by a delimiter character (it is "." or "/" symbol depending on language specified in Windows). Most computers follow a four digit format mm/dd/yyyy. For example, if your patient was born on the 21st of May, 1956, it is enough to enter "21.05.56"). The date format specified in your Windows system is used. That is why in some countries other sequence than "day-month-year" can be applied;

- enter the department (the number of ward, hospital etc.);

- enter a provisional diagnosis if it is nesessary;

- choose treatment type and template if it is nesessary;

- to enter the additional data (e.g. policy number, address, telephone number etc.) go to "Additional" tab and continue data entry.

The database does not contain card-files by default (all treatments are saved together). You can press the Change... button and create new card-file or select the other one which already exists.

If a patient has already been examined or received treatment and his/her card already exists in the database, then a patient with the most appropriate name will be offered while entering the name. If a patient card already exists in the database, then a new treatment will be saved to the existing patient card.

To add patient's photo click on the square at the right side of the dialog box and indicate the image (graphic) file.

Besides, you can type your name in "Doctor:" input box, assistant's name and technician's name in the "Assistant:" and "Nurse:" input boxes correspondingly.

If you want to perform treatment according to choosen treatment template (scenario), then choose the appropriate template. You can find more information in the "Treatment Templates" chapter.

To create treatment on the basis of entered data, press the ✓ button.

If the magnetic stimulator is plugged in and is connected to the computer USB port, then it would be switched on automatically after the new treatment creation or existed treatment opening.

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**Digital EMG and EP system could be used only with magnetic stimulator.**

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Devices could be switched on using menu command **Hardware|Device reset** (**[Ctrl+Shift+Del]**).

To switch off the device use **Hardware|Turn device off** menu command or ⏻ button on the front panel of the magnetic stimulator case.

If some patient's details were entered with a mistake, you can correct them using the **Treatment|Properties** menu item.

# 2.7. Status Bar

At the bottom part of the **Neuro-MS.NET** main window you can see status bar which shows the current state of the magnetic stimulator (Fig. 10).
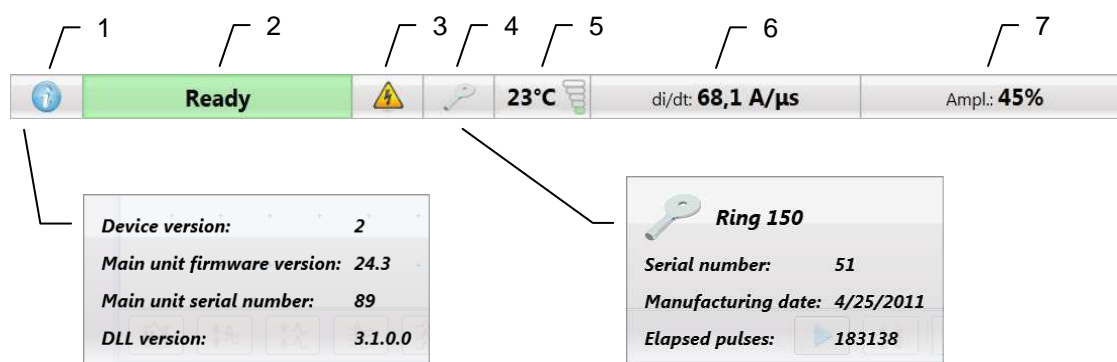
Fig. 10. The status bar of the magnetic stimulator.

If magnetic stimulator is switched on, status bar displays the following information:

1. **Information** — the dropdown element which contains detailed information about connected magnetic stimulator (main unit firmware version, main unit serial number etc.). To open the dropdown list, click on the element.

2. **Ready** — the readiness indicator of magnetic stimulator. The indicator highlights green, if the stimulator is ready to produce the pulse of the specified amplitude.

3. **High voltage** — the high voltage indicator. The indicator highlights yellow when the stimulator is switched on and high voltage is supplied inside the stimulator.

4. **Coil type** — the dropdown element which contains information about the type of used coil (manufacturing date, serial number, elapsed pulses). To open the dropdown list, click on the element.

5. **Coil temperature** — the element which shows the coil temperature. To the right of temperature value a 5-segment three-colored temperature scale. The segments of this scale highlight one by one after achieving the following temperature: first green segment — at less than 30º C temperature, second green segment – at coil temperature from 30º up to 34ºC, first yellow segment – at coil temperature from 34º up to 38ºC, second yellow segment – at coil temperature from 38º up to 41ºC, red segment – if the coil temperature exceeds 41ºC.

6. **di/dt** — the element which characterize the strength of magnetic field induced by the magnetic stimulator.

7. **Absolute amplitude** — the element which shows the stimulus amplitude in percents from the maximal power of the magnetic stimulator.

# 2.8. Treatment Algorithm

Perform steps described in the "The Very Beginning: New Treatment" chapter.

Use "Stimulation algorithms" tab (Fig. 11) to view and to edit the existing algorithm.
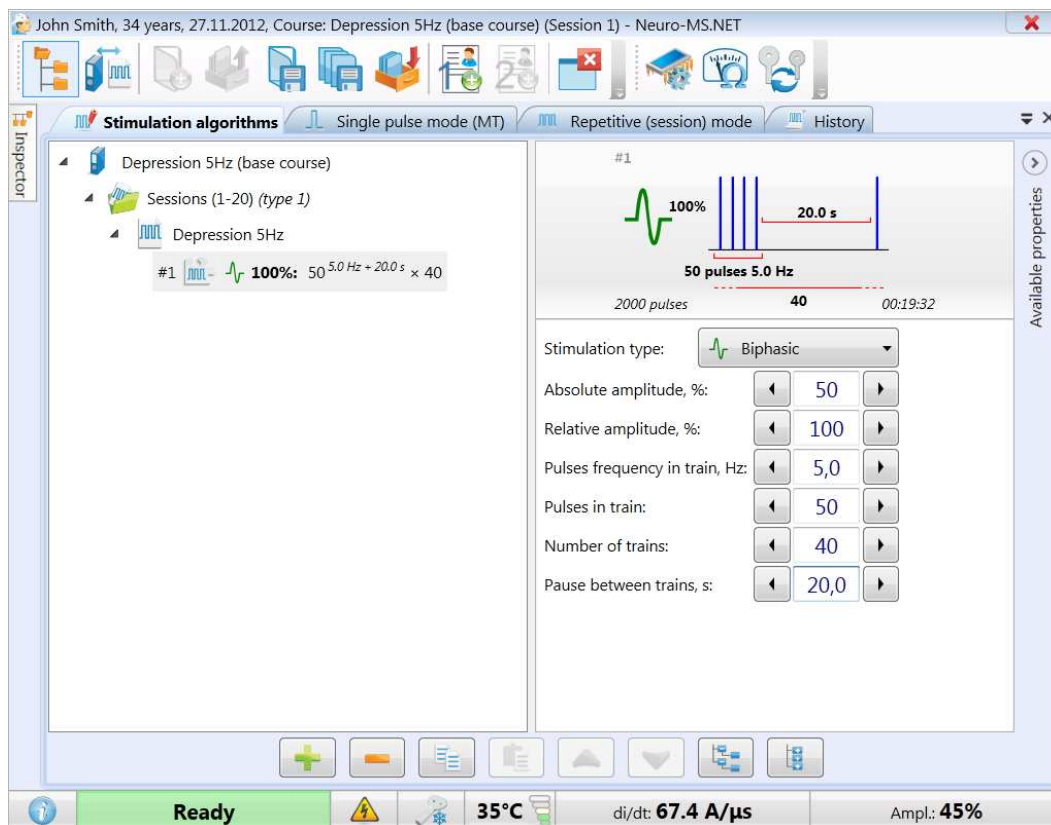
Fig. 11. The "Stimulation algorithms" page.

If you did not choose treatment template while creating the new treatment, then the program would open the "Stimulation algorithms" tab in order to let user to prepare stimulation algorithm manually.

The program offers two operation modes: "Course" and "Program". "Course" mode is the main treatment mode formed on the basis of medical protocol. This mode implies several procedures. "Programs" mode is the special treatment mode. It allows performing stimulation on one or more programs and implies only one procedure. To switch between modes use **Treatment|'Course'-'Programs'** menu command or  toolbar button.

On the "Stimulation algorithms" page you can change treatment structure easily and quickly.

You can find more information about organization and editing of treatment algorithms in corresponding chapters of the user manual (see "Course Templates" chapter to find information about "Course" mode and "Program Templates" chapter to find information about "Programs" mode).

# 2.9. Single Pulse Mode (MT)

"Single pulse mode (MT)" page (Fig. 12) helps to perform single pulse stimulation and to detect motor threshold (MT) on the defined area of body.
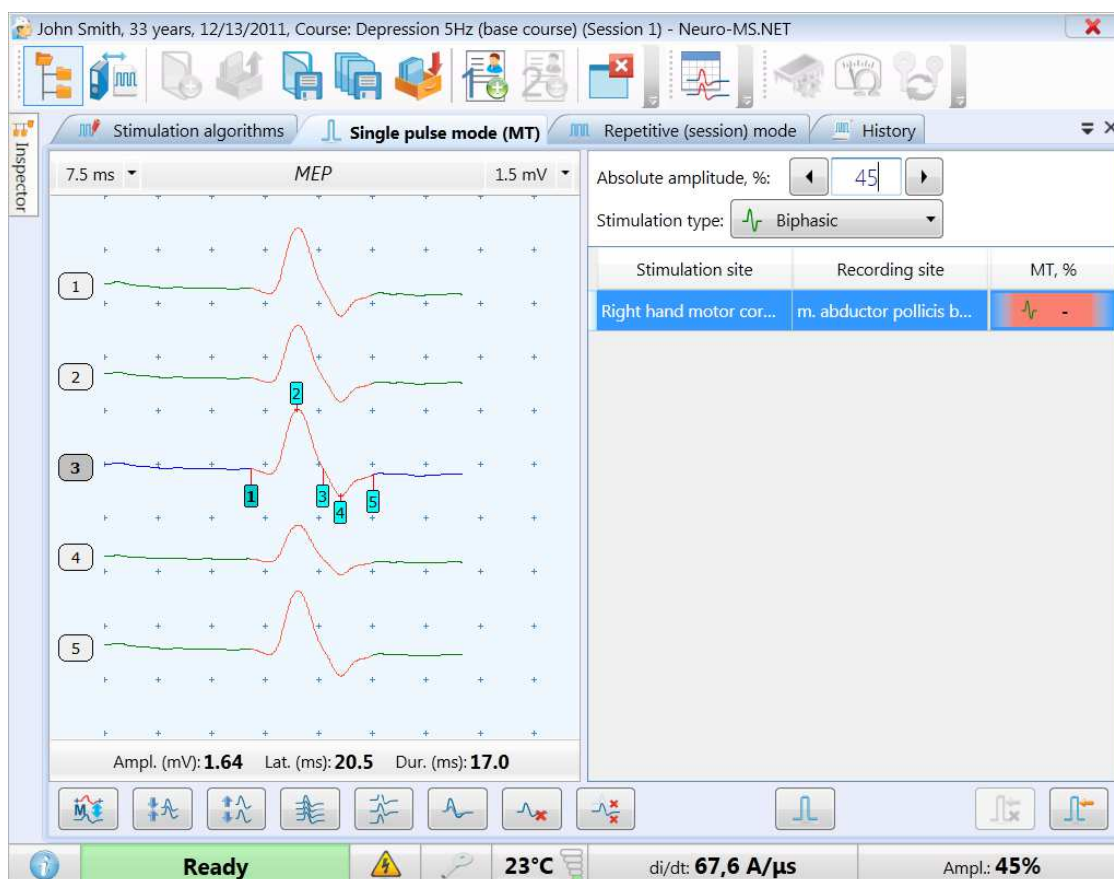
Fig. 12. The "Single pulse mode (MT)" page.

This technique is based on acquisition of bioelectrical responses of nervous system to the magnetic stimulus.

Before MT detecting, make sure that you choose the appropriate treatment algorithm (see "Treatment Algorithm" chapter) in order to find possible ways to record motor evoked potential (stimulation site — recording site).

At the left part of this window you can see motor evoked potential acquisition area. At the right part of this window single pulse mode parameters and table with possible ways to record motor threshold (MT) are displayed. Also in the table you can find the information about current MT value and stimulation type for its detection.

To emphasise the currency of running MT color background highlighting is used:

- Red — MT is not detected and it is required to detect it or there are critical differences between used equipment configurations (for example, last time motor threshold was detected using other type of coil).

- Yellow — *only for "Course" mode*. MT is not detected and it is not required to detect it during the session.

- Green — MT is detected.

To find the cause of MT value invalidity, click on the "MT,%" field with left mouse button.

In the "Course" mode MT value currency is specified by the "MT update period" parameter. This parameter is set in course properties (see "Treatment Algorithm" chapter). For example, if this parameter is 5 and MT was detected during the first procedure, then the program would remind you to update MT value only during the sixth procedure (background highlighting would change colour from green to red).

MT detection can be performed objectively using digital EMG and EP system or subjectively on the basis of contraction of muscles during the stimulation.

If digital EMG and EP system is used for MT detection, then run the electrode impedance measuring process before the stimulation. To run this process use menu command **Hardware|Impedance measurement ([Ctrl+Z])** or  toolbar button. Place the electrodes (you should start with the ground electrode) simultaneously observing the impedances on the screen (Fig. 13).
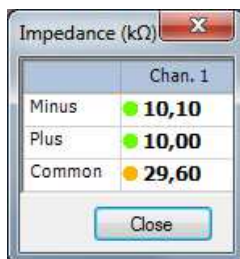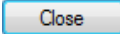


Fig. 13. The impedance measurement.

> **Stimulated area and placement of electrodes should correspond with choosen way of MT recording (stimulation site — recording site).**

If there is too high impedance in some recording site (red or orange highlighting), it is necessary to position the electrode more carefully. Try to obtain the acceptable level of impedance. To finish the electrode impedance measuring process press  button or **[Esc]**. If you are experienced enough, you can perform treatment without impedance measuring of the placed electrodes.

It is recommended to perform signal monitoring using **Hardware|Monitoring** menu item and make sure that there are no noise and artefacts on the record.

In "Absolute amplitude" field set the minimum (starting) value which would be enough to evoke the motor evoked potential.

Move the coil to the stimulation site.

Perform the single pulse stimulation using  "Stimulus" button at the bottom of the page or the same button on the coil.

If you use digital EMG and EP system, the program obtains patient responses after each pulse in the form of traces (left part of the page on Fig. 12). The program analyses traces and marks M-waves if it is possible.

By default the M-wave search is performed for the whole trace. If you want to change the range of M-wave search, use **Setup|Edit…** menu item, "Software" tab, "Single pulse mode" group box. If the "Possibility to set M-wave search range" checkbox is marked, the ![button] button appears in "Single pulse mode" window. Use this button to set the M-wave search range by time, duration and amplitude (Fig. 14).
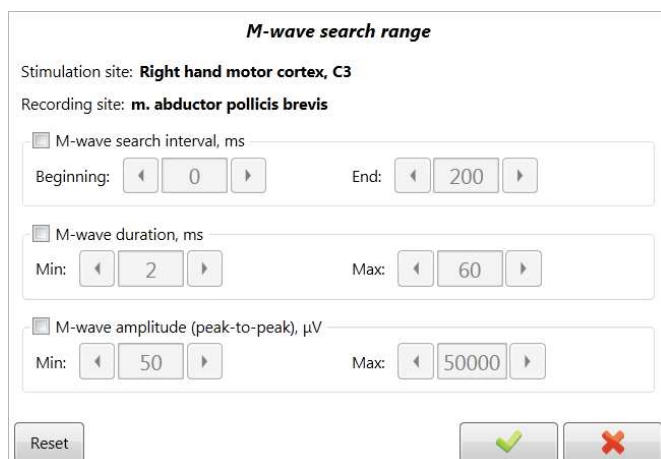


Fig. 14. The window of M-wave search range setting.

In case an error message appears during the acquisition, check the device connection to the computer and then execute the **Hardware|Device reset** menu command.

Perform several pulses moving the coil over the stimulated area to obtain the acceptable result. If the required M-wave was not obtained, try to increase the absolute amplitude value.

All acquired traces refer to examination conditions and depend on the stimulation amplitude, the stimulation type and the way to record MT (stimulation site – recording site);

If M-wave is not found on the trace automatically (very low amplitude), you can start the manual search by means of the mouse cursor – press **[Alt]** and holding it click the mouse left button on the supposed M-wave location.

If the markers are placed inaccurately you can correct their placement with the mouse.

You can find more information about working with traces in the "Working with Traces" chapter.

At the bottom of the screen the data for selected trace (M-wave amplitude (in mV), latency and duration of acquired potential (in ms)), and the number of traces which contain M-wave are displayed.

At the bottom part of the page you can find the information about M-wave amplitude in millivolts, latency and its duration in milliseconds. These values are obtainable and individual only for selected trace with defined M-wave.

To analyse basic M-wave parameters (latency, duration and amplitude) for all traces, make "M-wave analysis" table visible using **View|M-wave analysis** menu command or [icon] toolbar button. The "Single pulse mode (MT)" page will have the view shown on Fig. 15.

> **"M-wave analysis" table contains the information about traces with defined M-wave.**

When selecting the trace the corresponding line in the quick analysis table is automatically selected. And vice versa, when selecting a line in the quick analysis table (by the mouse or arrow keys), selecting of the corresponding trace takes place.
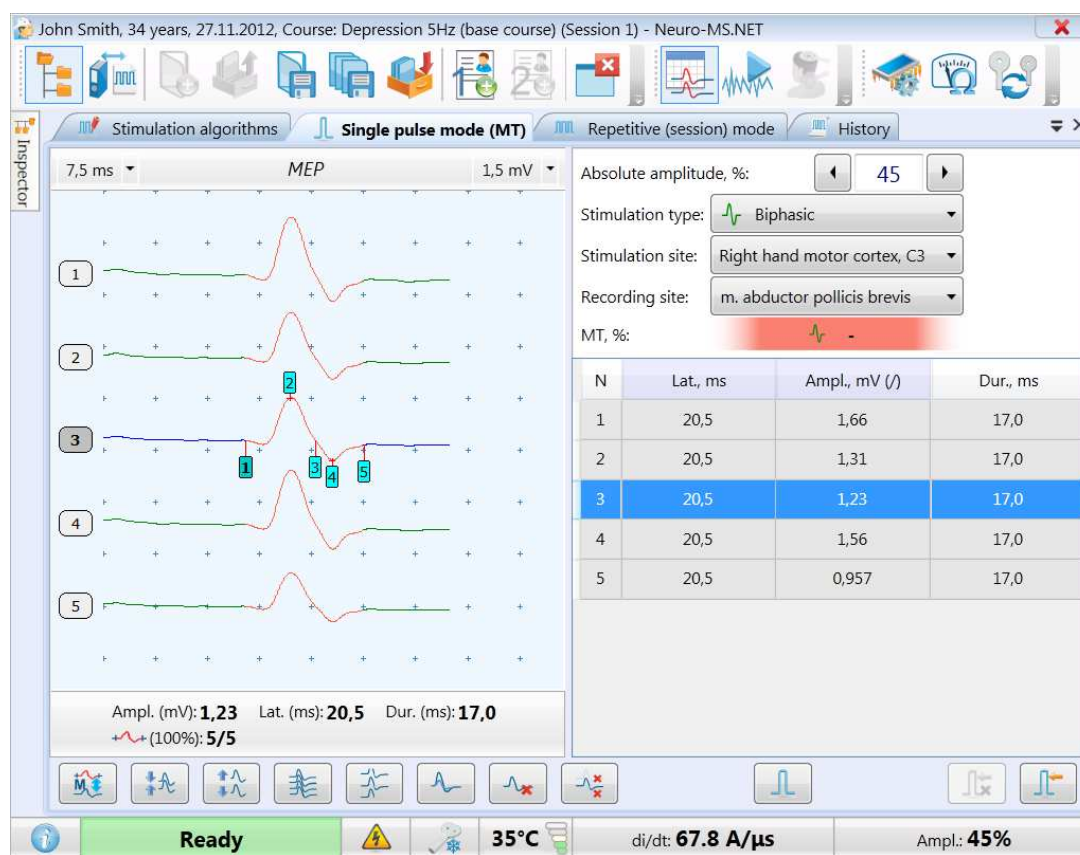


Fig. 15. The "Single pulse mode (MT)" page. M-wave analysis.

After receiving the qualitative M-wave start MT acquisition diminishing the amplitude value.

Find the minimal stimulus intensity required to receive the qualitative M-wave during several pulses. It is the motor threshold (MT). Finish the stimulation. To save the obtained result, press [icon] "Fix MT" button, to reset results press [icon] "Reset MT" button. Remember that if you fix MT, all obtained traces are saved in the database.

Obtain and fix MT for other sites analogously.

> **Monophasic stimulation can be performed only if you use Neuro-MS/D magnetic stimulator with the expansion unit.**

If referece data for stimulation site and recording site is available, you can review it using **View|Help window ([F1])** or  toolbar button. You can find the detailed information about adding and editing the reference data in 3.1 "Recording Sites" and 3.2 "Stimulation Sites".

# 2.10. Repetitive (session) Mode

"Repetitive (session) mode" page (Fig. 16) helps to perform repetitive magnetic stimulation according to predetermined programs (see "Treatment Algorithm" chapter). When you first open "Repetitive (session) mode"page the first unexecuted stimulation program will be selected automatically.
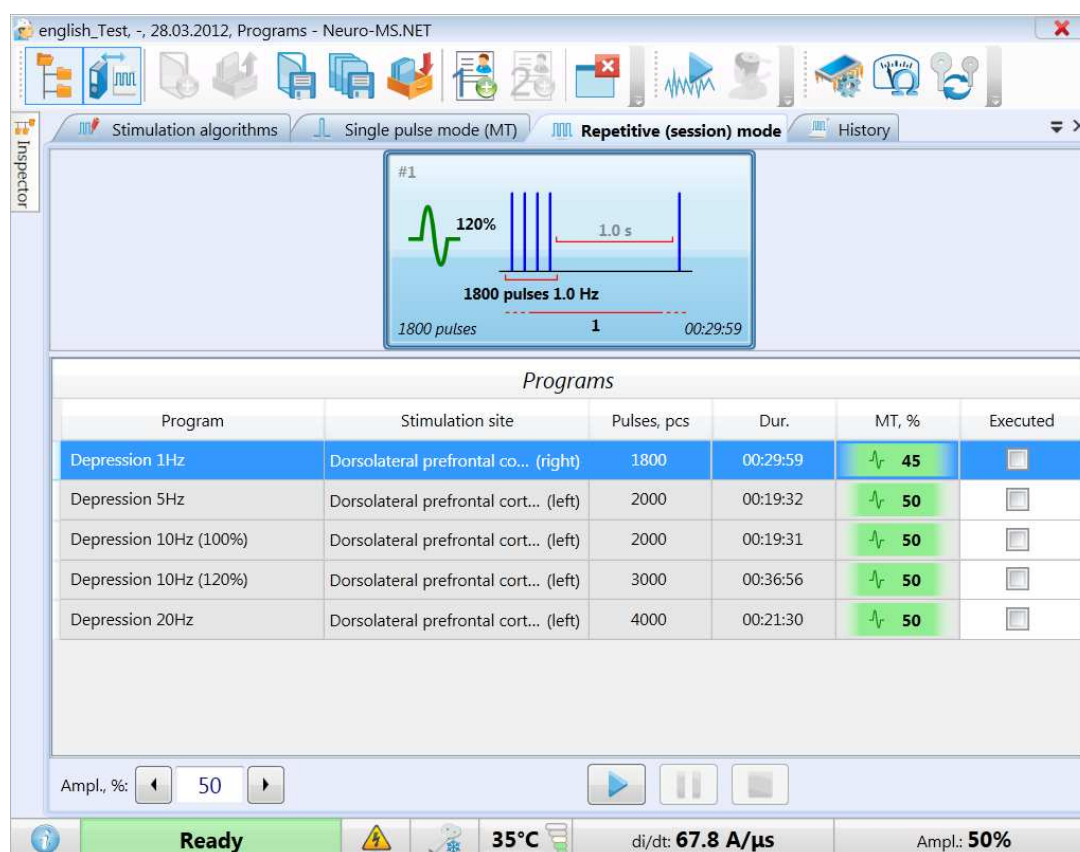


Fig. 16. The "Repetitive (session) mode" window. "Programs" mode.

The table of stimulation programs contains program name and stimulation parameters:

- Stimulation site — the area of body affected by the repetitive magnetic stimulation.

- Pulses, pcs — the number of pulses in the program.

- Dur., s — the program duration in seconds.

- MT, % — MT value used to calculate relative stimulation amplitude for each program. To emphathise the currency of running MT value color background highlighting is used (analogous to highlighting described in the "Single Pulse Mode (MT)" chapter).

- Executed — flag of stimulation program execution (the program set the flag automatically when the stimulation program finishes, but you could set it manually (see below)).

In the "Course" mode "Repetitive (session) mode" page displays all stimulation programs available in current session (Fig. 17).

In this mode the stimulation program table contains the information concerning the program belonging to certain session type. The term "Session type" is described in "Course Templates" chapter. The table header provides the opportunity to move to the next or to the previous session.
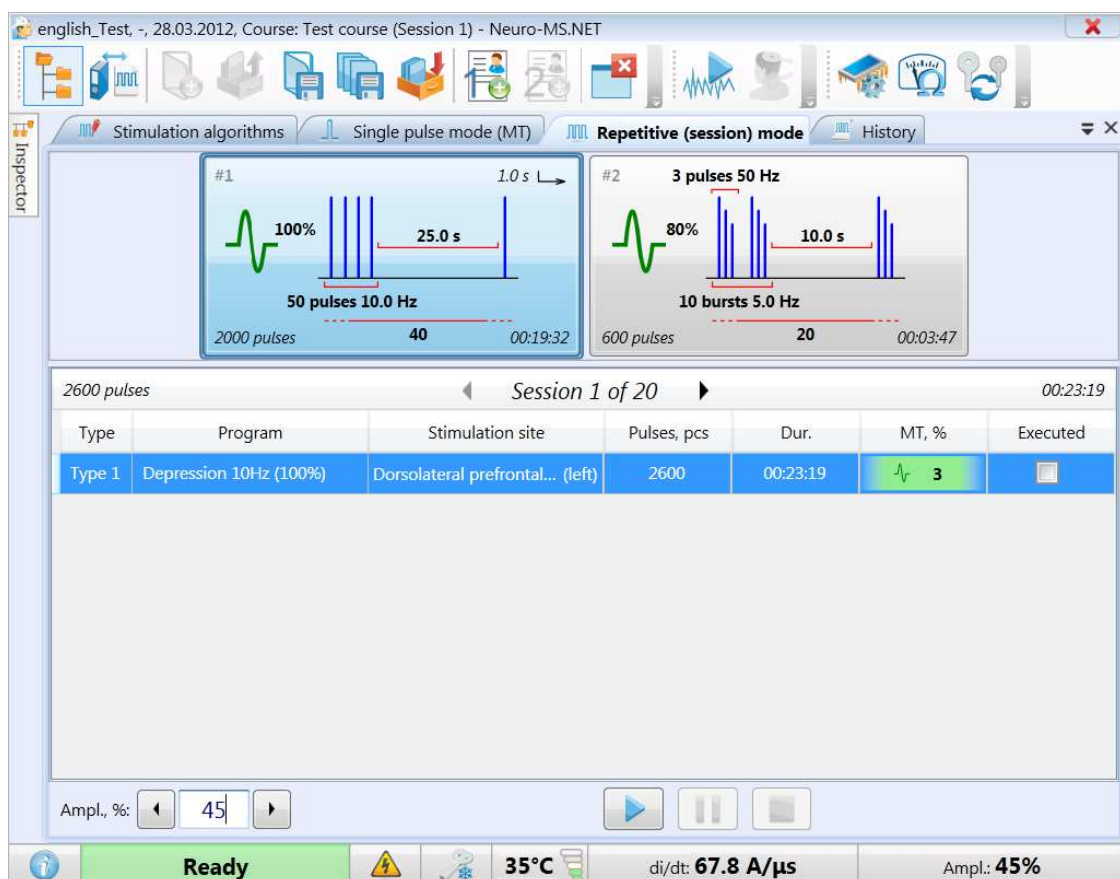


Fig. 17. The "Repetitive (session) mode" window. "Course" mode

The stimulation program can include several subprograms. At the top part of "Repetitive (session) mode" page you can see the schematic plan of stimulation subprograms. The scheme interpretation can be found in the "Basic Notions" chapter. In case a complex stimulation program is applied, you can select the subprogram to start the stimulation first. To select the other stimulation subprogram, click the corresponding area on the stimulation program graph with the left mouse button. After that, the selected subprogram will be framed with blue.

To control repetitive stimulation use three buttons located at the bottom part of "Repetitive (session) mode" page:

- ▶ — start stimulation;

- ⏸ — suspend/resume stimulation;

- ⏹ — stop stimulation.

Also you can use "Pulse" button on the coil to control the stimulation. You can use "Pulse" button instead of **[Enter]** working with dialog boxes. After stimulation start the program launches autotesting to define the ability to perform the stimulation program. After that the program will display messages concerning the restrictions inhibiting the stimulation performance if it is nesessary. For example, if the expansion unit is missing and the stimulation program contains monophasic stimiulation, the message concerning the inability to perform the program will appear. Or in case you face the situation when the program parameters do not correspond to the device hardware you will be offered to change the stimulation parameters according to the device capabilities (Fig. 18).
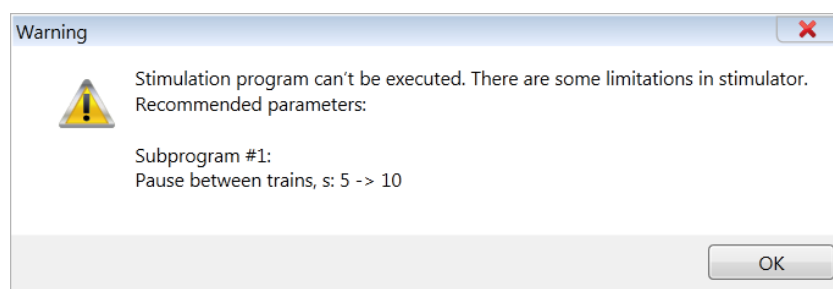


Fig. 18. The restriction message example.

> **The stimulation parameters are not changes automatically because of high safety requirements to rTMS.**

In case the stimulation program autotesting was successful, the message box reminding of new coil position would appear. The stimulation starts after the requirement confirmation.

You can monitor the stimulation process in the popup element. The element is active during the stimulation and contains the information about the stimulation program (Fig. 19).
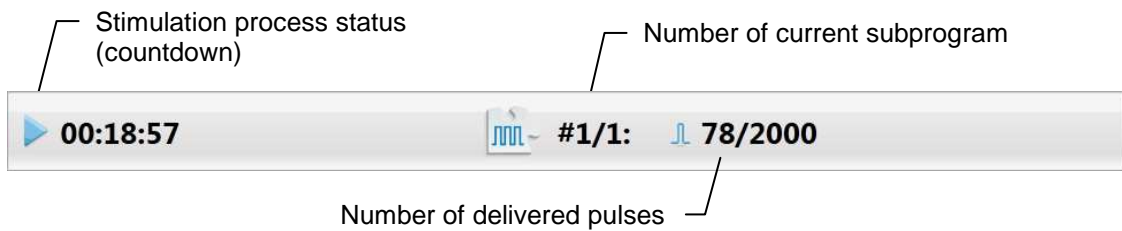
Fig. 19. Information about stimulation process.

The stimulation process is shown on the stimulation subprogram graph by changing background color (Fig. 20).
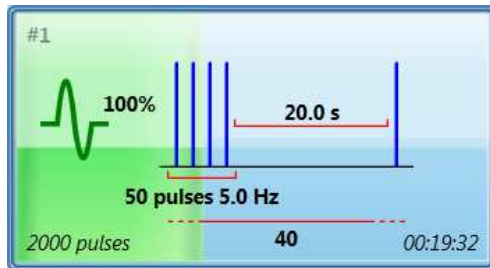


Fig. 20. The stimulation subprogram graph.

After the finishing of each stimulation program if all subprograms were fulfilled it would be marked automatically as "Executed" and corresponding data would be saved in history. Then the program goes automatically to the next unexecuted program, tests it and if the stimulation site has not changed will continue the stimulation.

> **Stimulation programs can be executed in consecutive order automatically only in "Course" mode.**

To mark the program as "Executed" manually, click the left mouse button in the "Executed" field and confirm your actions. To run again the executed program, uncheck the "Executed" option. In that case the corresponding information would be erased from the history.

In "Course" mode after the last stimulation program fulfillment the program will ask you to finish the session. In case you agree the program will go automatically to the next session.

If the coil is overheated and you have a reserve coil, you can use the quick coil replacement function. You can do it using **Hardware|Coil replacement** menu command or by pressing button in the beginning and in the end of replacement. In case you activate "Coil replacement" process during the performing of the stimulation program, the program execution will be paused and will be continued automatically after the coil replacement.

# 2.11. History

"History" page (Fig. 21) contains information about stimulation history. The history contains data about fixed motor threshold (including traces) and about performed stimulation programs. On the basis of the history **Neuro-MS.NET** define executed and unexecuted programs and the necessity to update MT value.

At the left part of the page the list of events by date is represented. At the right part of the page you can see the detailed description of every event from the left part of the page. You can delete the event using ▭ button  and confirming deletion. Keep in mind that element deletion influence the whole treatment. For example, the executed program will become unexecuted in case you delete the corresponding element from history.

To work with traces received during MT fixation, you can use all facilities described in the "Working with Traces" chapter.
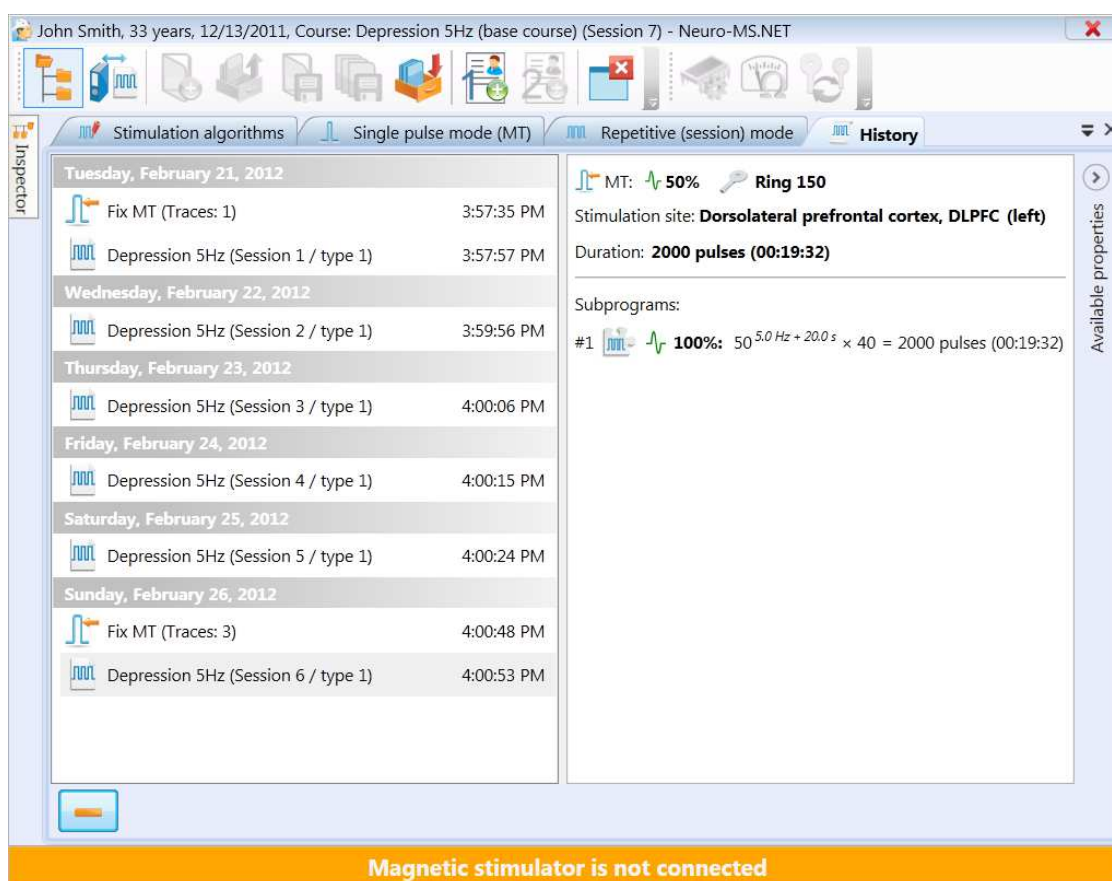


Fig. 21. The "History" page.

# 2.12. How to Print the Treatment Report

The main way to receive printed treatment results is to generate the report and to print it.

To create new report, use **Report|New report 1** menu command (**[Ctrl+R])** or toolbar button. To print the report use **Report|Print** (**[Ctrl+P]**) menu command. You can view the report before printing and make corrections (all the information can be corrected).

To create reports of different types use **Report|Template editor** menu command.

# 2.13. How to Rewiew Previous Treatments

To review (analyse) or continue the created treatment use **Treatment|Open treatments manager** menu command (press **[Ctrl+O]** or toolbar button). The program will open "Treatments manager" dialog (Fig. 22).

In case you use Neurosoft database to store results, the list of treatments in "Treatments manager" can contain information not only about treatments performed by **Neuro-MS.NET**, but also about examinations performed by other **Neurosoft** programs.
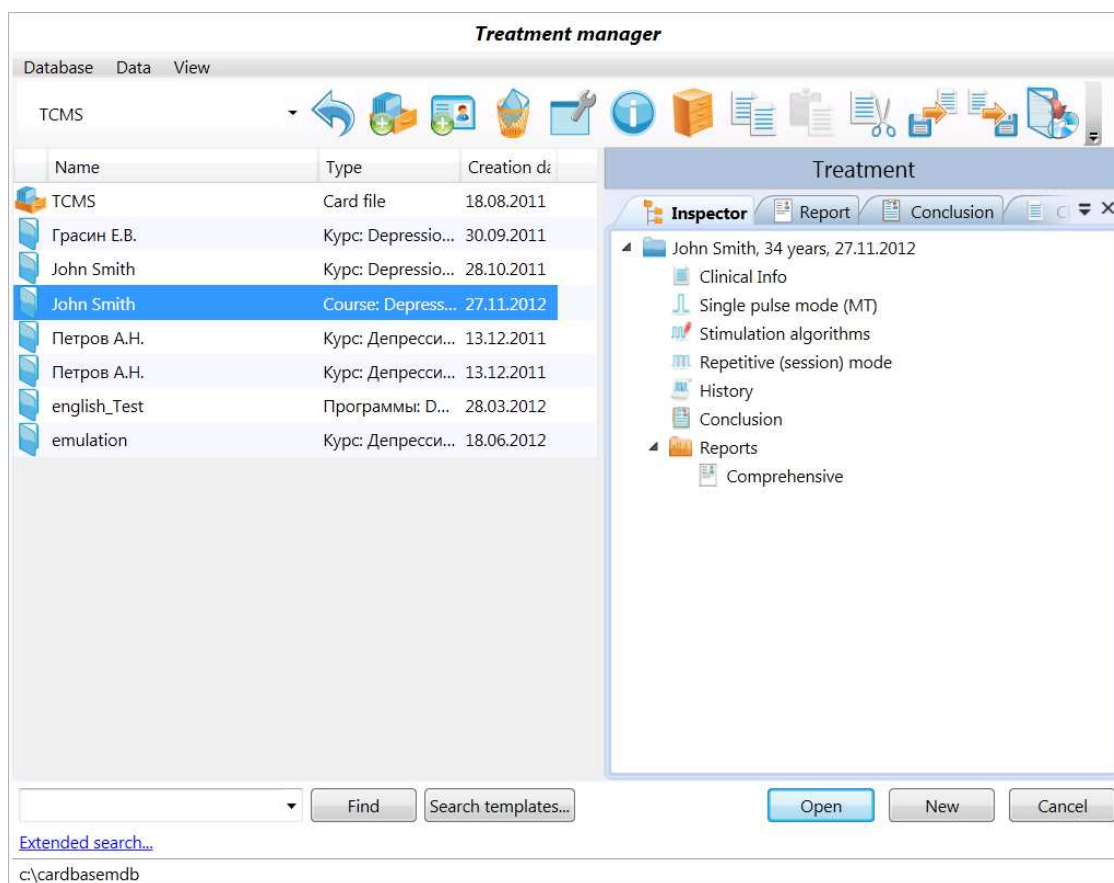


Fig. 22. "Treatments manager" dialog.

To open the treatment, select it in the list and press ⬚ *Open* button or double click the patient's surname.

To create a new treatment for selected patient, press [ New... ] button. This button corresponds to **Treatment|New** menu command. The difference is that you select the patient from the list.

To switch between "Patients" and "Treatments" view modes in "Treatments manager" dialog, use context menu (Fig. 23). In "Patients" mode the right part of the dialog shows the list of performed treatments. To open the treatment, double click the treatment name. To open the patient card, double click the patient's surname (Fig. 24). To return to the list of patients, press [ Backward ] button.
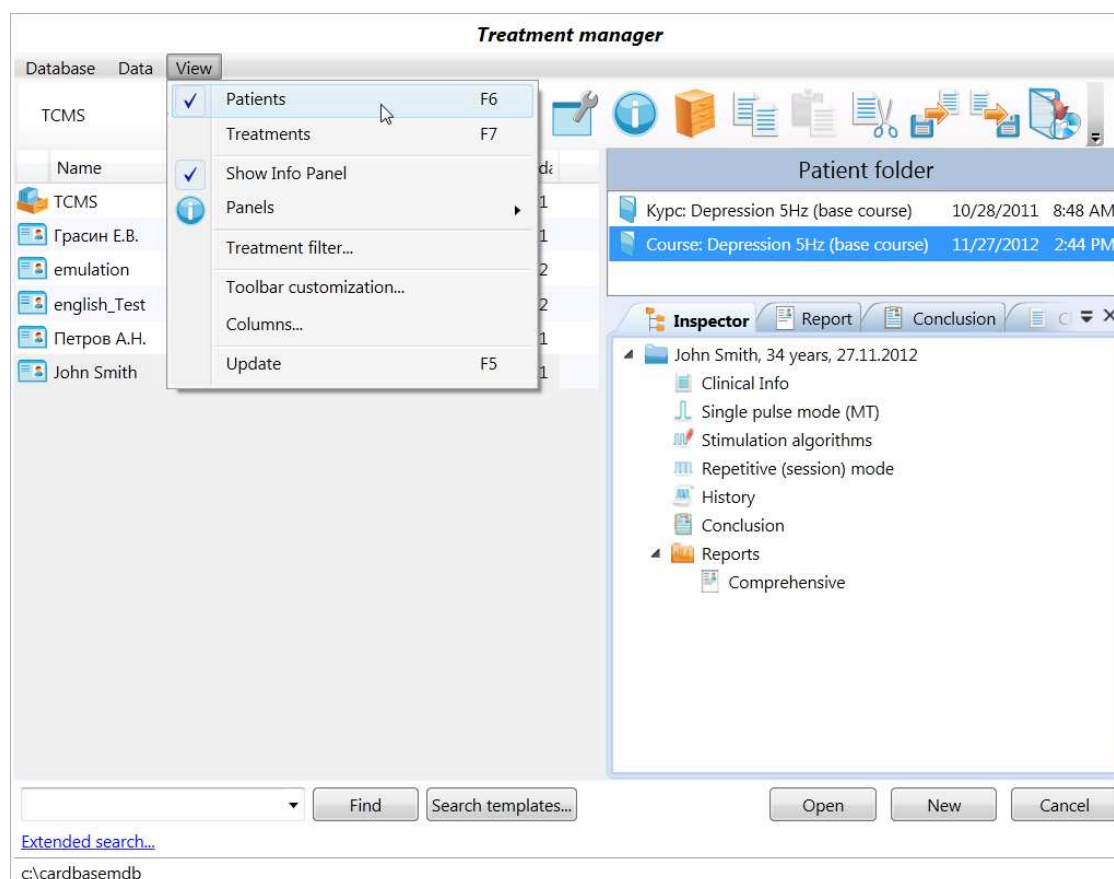


Fig. 23. Switching between view modes.
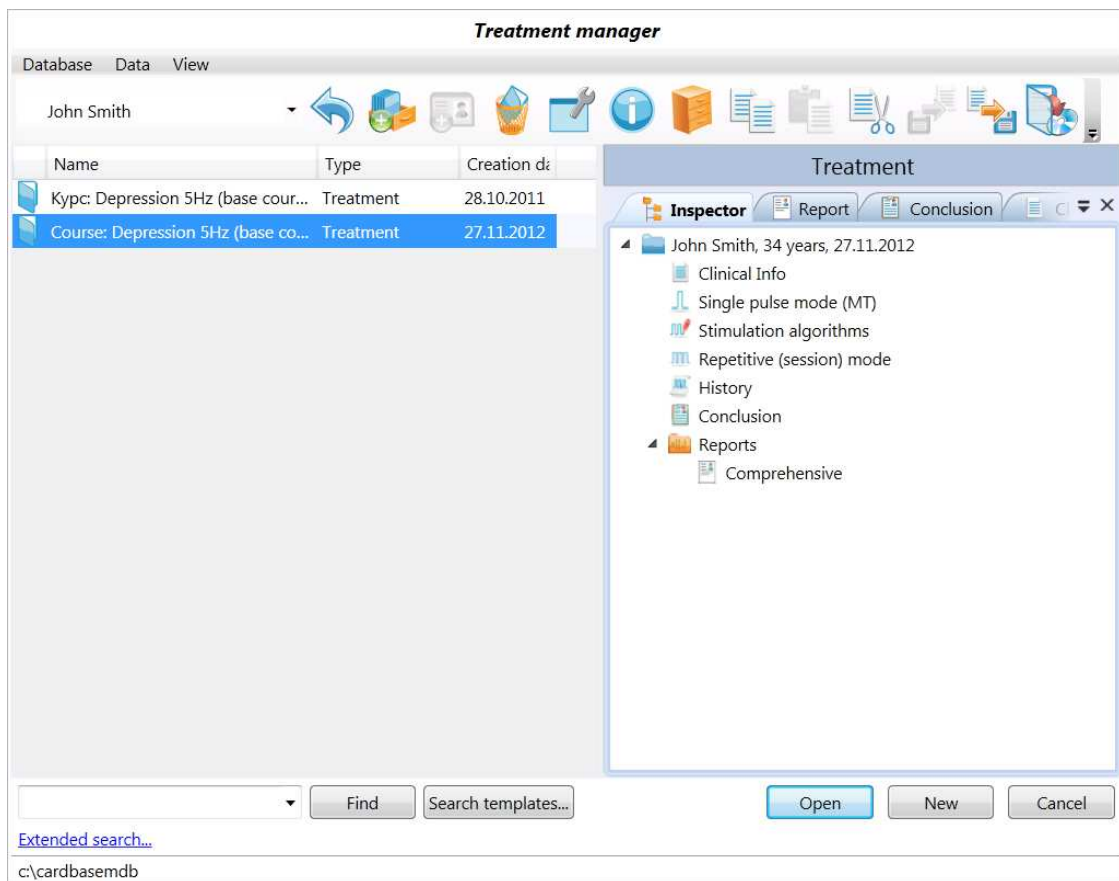
Fig. 24. Patient card.

Using "Treatments manager" you can create not only card files of any nesting level ( button), but also new patient cards ( button). To configure data presentation at the right part of the dialog use  button. Treatments can be exported to the external archive (for example, to be moved to another computer) using  button and imported from the archive using  button .

To connect existing database or to create new one, use  button. By default the program creates MDB *(Microsoft Access)* database in *C:\cardbaseMdb* directory (folder). You can create not only MDB, but also Microsoft SQL and MySQL databases.

To find patient or treatment use search field located in the bottom-left corner of "Treatments manager" dialog (Fig. 25). You can type only the part of the name, diagnosis or other data and press  button. In this case the program will display all treatments which contain this string.
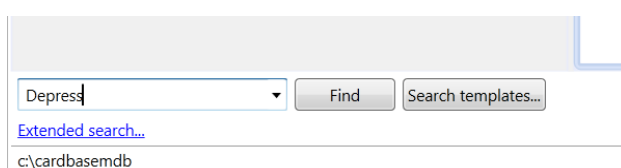


Fig. 25. Search field.

On treatment course opening the first unexecuted session will be chosen automatically.

# 2.14. How to Exit the Program

To exit (close) treatment, use **Treatment|Close** menu command or press  toolbar button.

To exit the program, choose one of the following ways:

- **Treatment|Exit** (**[Alt+X]**) menu command;

-  toolbar button;

- click on the  close button in the upper-right corner of the program window.

# 2.15. Working with Traces

**Neuro-MS.NET** provides ample opportunities for you to work with traces recorded from a patient. Recorded traces are displayed in acquisition window.

To the left of each trace in the window there is a button with its number (Fig. 26). If the trace is selected then the button has the heading in bold type with a dark background. Most of menu commands affect only the selected trace. To select the trace, click the left mouse button on the trace or on the adjacent button. To select several traces click the left mouse button holding the **[Ctrl]** key on the keyboard. All traces on the display panel can be selected by **Trace|Select all** menu command. To move to the next trace use **Trace|Next** (**[Ctrl+Down]**) menu command, to the previous one – **Trace|Previous** (**[Ctrl+Up]**).
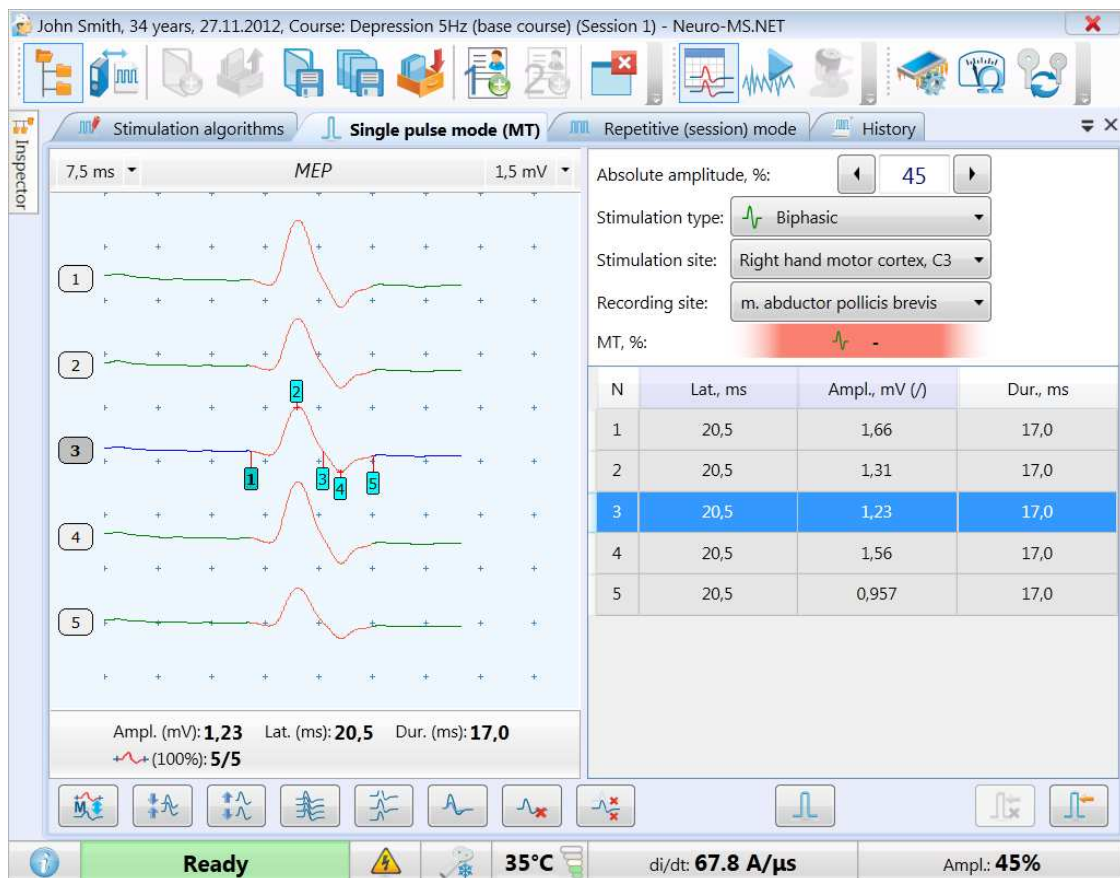
Fig. 26. "Single pulse mode (MT)" page.

To change a trace position, shifting it upward and downward on the screen, drag the button with the trace name by the mouse. Place the mouse cursor on the button, press the mouse left button and, holding it, drag the button to the right place and then release the mouse button. Moreover, the position of traces on the screen can be changed by **View|Traces** menu command.

In fact, any selected trace can be deleted by **Trace|Delete** (**[Ctrl+Del]**) menu command. To delete several traces simultaneously click on them with the left mouse button holding the **[Ctrl]** key and then select **Trace|Delete** menu command. It is also possible to delete all the traces except selected ones by **Trace|Delete all except selected** menu command.

The above-mentioned actions are duplicated with buttons at the bottom of the screen:

-  — place traces closer to each other;

-  — place traces distant from each other;

-  — make all traces visible within the window;

-  — set the default distance between traces;

-  — superimpose all traces;

-  — delete selected trace (traces);

-  — delete all traces exept selected.

To review the zoom-in trace fragments, use the "magnifier" mode. To activate this mode, press and hold **[Ctrl]** and **[Alt]** keys on the keyboard. The "magnifier" will appear on the screen (Fig. 27). You can shift the "magnifier" by moving the mouse keeping **[Ctrl]** and **[Alt]** keys pressed. If you release the keys, the "magnifier" will disappear. To change the ratio of "magnifier" zoom-in, use mouse scroll.
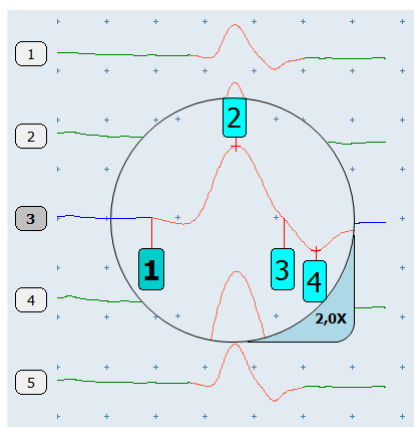


Fig. 27. "Magnifier" mode

To change the scales of traces use following commands (Table 1).

Table 1. Commands to change trace scales

| Parameter | Menu command | Hotkey |
|---|---|---|
| To increase sensitivity (vertical scale) | **View\|Sensitivity\|Increase** | Grey **[+]** |
| To decrease sensitivity (vertical scale) | **View\|Sensitivity\|Decrease** | Grey **[–]** |
| To increase sweep (horizontal scale) | **View\|Sweep\|Increase** | Grey **[*]** |
| To decrease sweep (horizontal scale) | **View\|Sweep\|Decrease** | Grey **[/]** |

To specify scale (scale factor of a grid), it is more convenient to use dropdown lists for scales located in the title of registration window (Fig. 28).
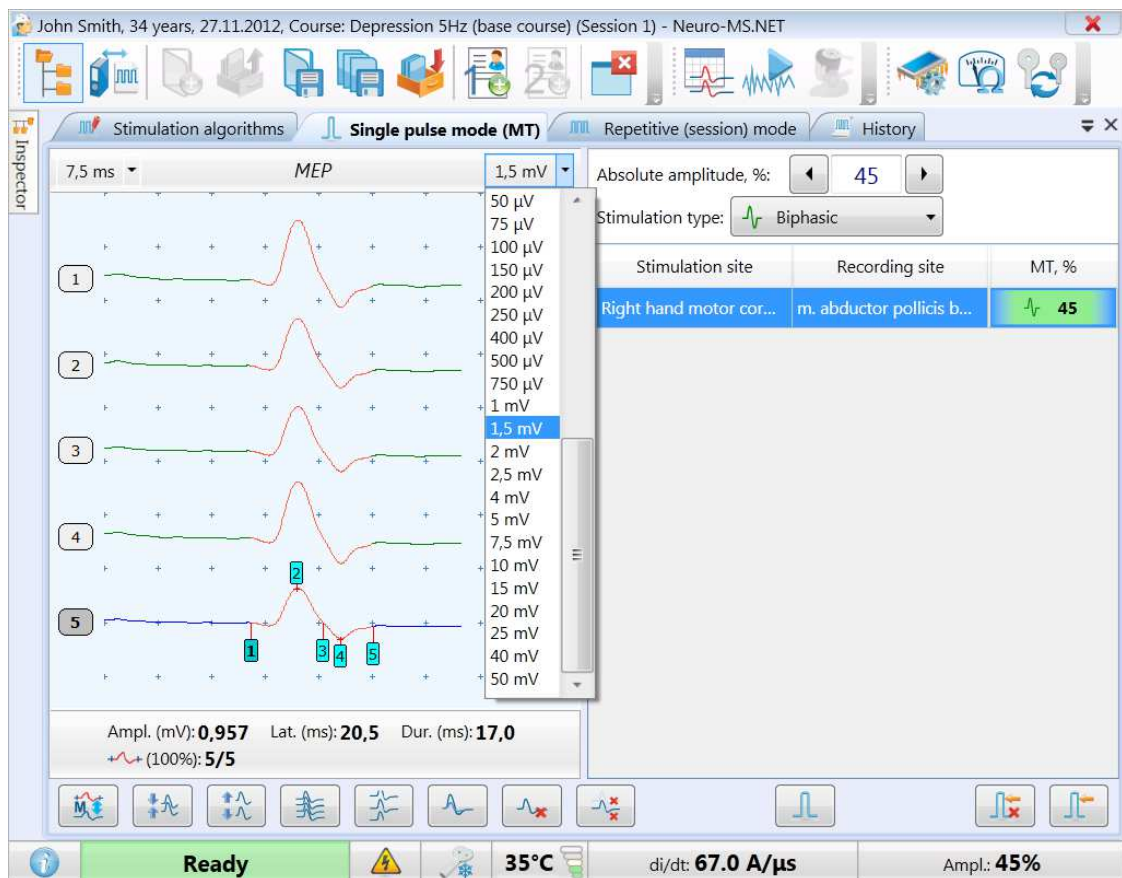
Fig. 28. Scale setting.

Automatical arrangement of M-wave markers occurs after the trace acquisition. If M-wave is not found on the trace automatically (very low amplitude) you can start the manual search by means of the mouse cursor – press **[Alt]** and holding it click the left mouse button on the supposed wave location.

On the M-wave there can be 5 markers of the feature points:

1 — wave onset marker;

2 — negative peak marker;

3 —negative peak end marker;

4 — positive peak marker;

5 — M-wave ending marker.

Conduction block state on the trace can be changed either by **Trace|M-wave response on/off toggle** menu command or  button located at the bottom of the screen. This command is applied to the selected traces and can be applied to several traces simultaneously.

To correct marker position on the trace, move the mouse cursor to the marker (the cursor changes its view to ) and then press the left mouse button, drag

the marker to a new place and release the mouse button. After shifting the markers, automatic renewal of analysis windows takes place (see below).

To setup the appearance of acquisition window, trace management at signal acquisition, marker names and visibility use **Setup|Edit…** menu item, "Software" tab, "Trace review" group box. The trace review panel is represented in Fig. 29.
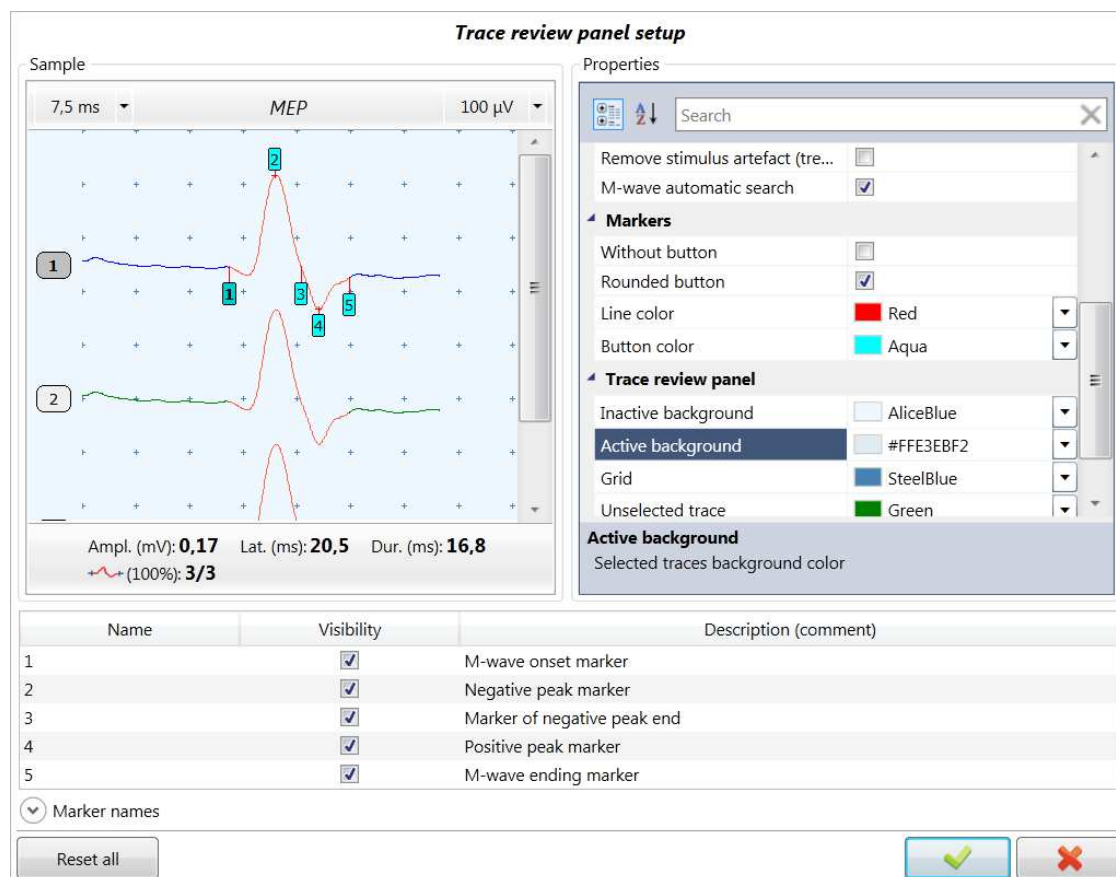


Fig. 29. Trace review panel setup.

# 2.16. Treatment Reports

Treatment reports are saved in the database together with the treatments data. Besides text, the treatment report can include tables, graphs and pictures. There is a possibility of both automatic report generation and input of any information using the computer keyboard. The program allows creating two types of reports: built-in and Microsoft Word format (Microsoft Word 2007 or later version is necessary). You can select the type of exam report using **Report|Use Microsoft Word** menu command (Fig. 30).
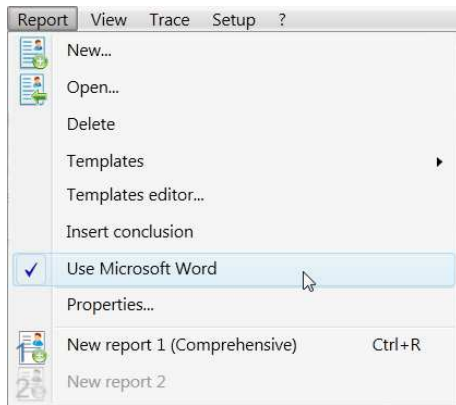
Fig. 30. Selection of report type.

The built-in report is similar to the standard WordPad program in Windows. The editor has such advantages as fast work, no necessity to install additional software and good quality of the created report (Fig. 31).
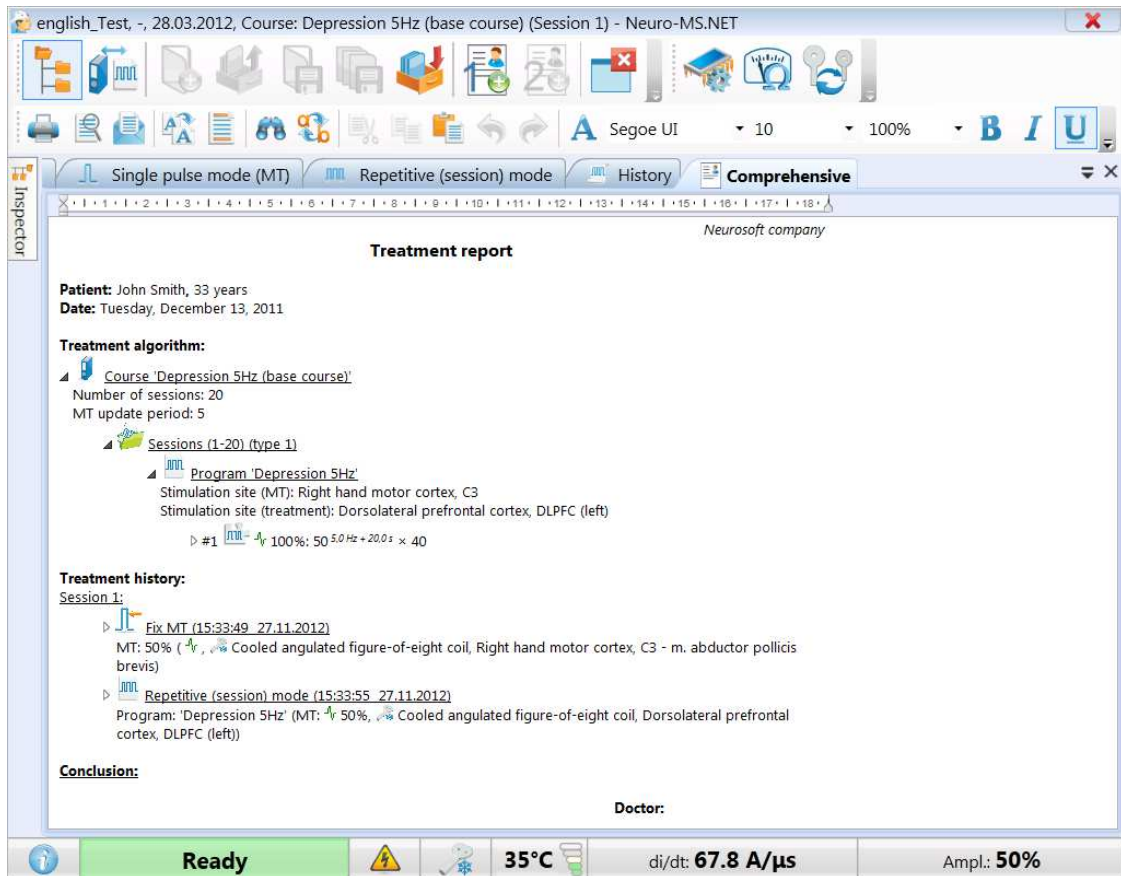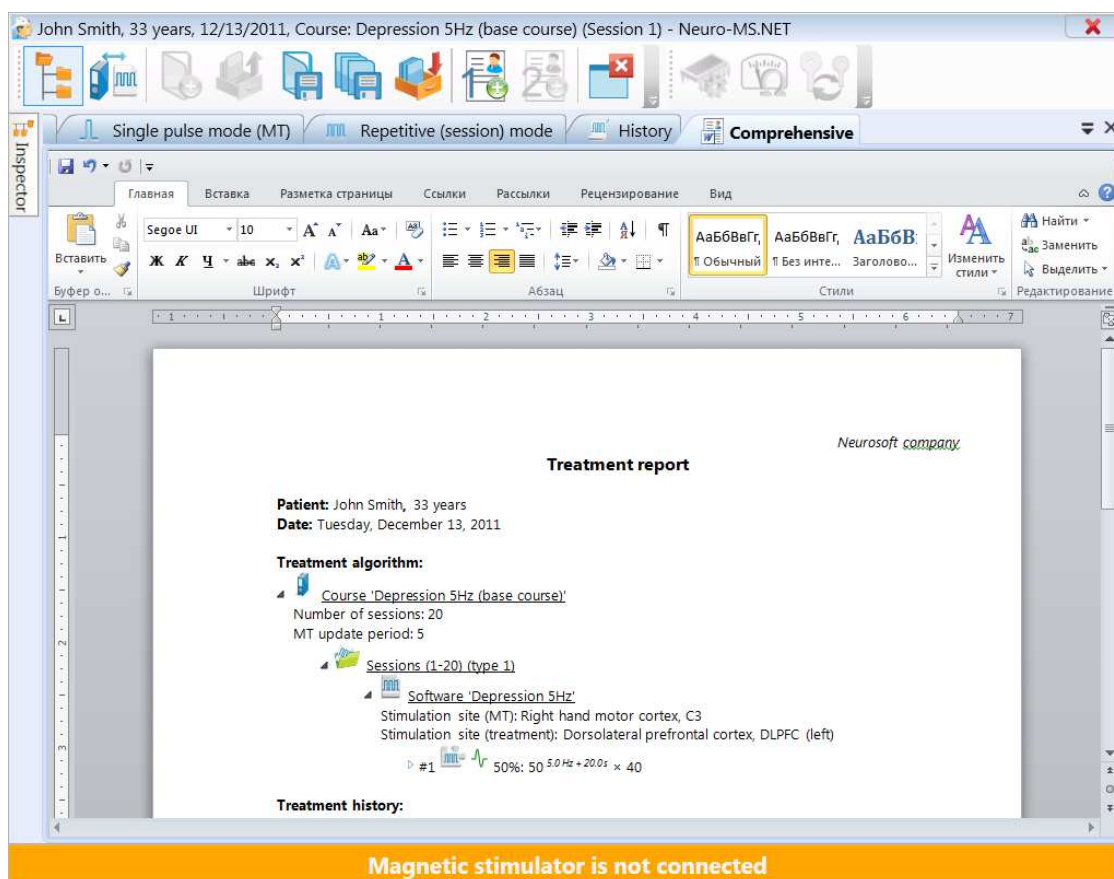


Fig. 31. Build-in report.

Fig. 32. Microsoft Word report.

Microsoft Word report allows obtaining access to all facilities of Word editor developed by Microsoft Company (Fig. 32). However, to work with this editor Microsoft Word must be installed on your computer.

To create a new treatment report use **Report|Templates** menu command. In the menu select the template according which the report will be generated. To speed up the work any of two report templates from the list can be linked with **Report|New report 1** and **Report|New report 2** menu commands. For this purpose use **Set-up|Change** menu command, "Software" page, "Default treatment report". The number of reports is unlimited.

Treatment report is generated according to the special report template in which the certain information and its view in the report are indicated. The number of generated report templates is unlimited.

By default, reports are saved together with the treatments in the database. To copy reports simultaneously to any catalogue (folder) on the computer disc, check the "Copy reports to folder" checkbox (see "Hardware and Sorftware Configuration Settings" chapter, "Report" tab) and select folder name. Therefore, when the report is being saved to the database, it will be copied to the indicated catalogue at the same time.

To print the report use **Report|Print** menu command. Also the report can be exported to the external file (**Report|Export** menu command) or sent by e-mail (**Report|Send** menu command).

Working with a new treatment it is convenient to enter some information to "Clinical info" and "Conclusion" windows. Further their contents can be copied to the exam report manually (**Report|Insert conclusion**) or using the report template.

# 2.17. Treatment Report Templates

The treatment report templates are powerful mechanism to speed up the report creation. The sequence, composition and type of information included in the report are defined in the template. Several templates are provided with the program by default but you can change these templates and create the new ones taking into account the concrete requirements. This mechanism provides the flexible system of the report generation.

To edit the report templates, use **Report|Template editor…** menu command. The report template editor is shown in the Fig. 33.
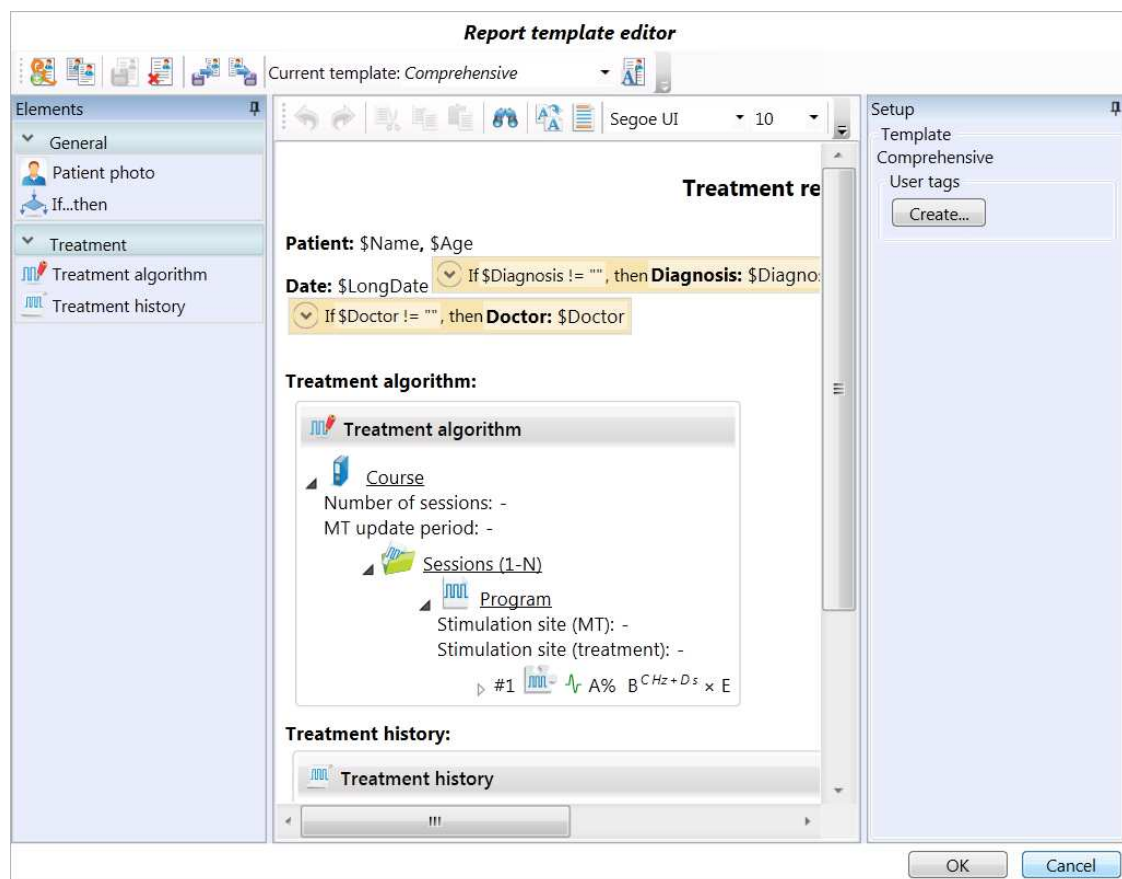


Fig. 33. Report template editor.

The toolbar for the report template control is located at the top part of the window. Using the buttons of this toolbar you can create the new report templates, remove the existing ones, import the templates from files, export the templates to files (for example, to copy to another computer) and rename them.

The combo-box of the available report templates is located to the right. After the selection of the required report template from this list, you can start its editing. The window of the template manager is divided into three parts. The left part contains the list of the information available for inclusion to the report (list of elements or blocks). All the report elements are divided into groups which names are indicated on the tabs. To select the active tab, click it with the left mouse button. To include the required element to the report template, drag it with the mouse to the middle part of the window.

The report template editor is located at the middle part of the window. It contains the elements which are to be included in the treatment report. It is possible to change the report template using the keyboard and by adding the elements (blocks) from the list. The list has a tree structure, i.e. some elements can contain other elements.

You can add some report data (for example, name and age of a patient) using tags in the report template text. When generating the report, all tags will be replaced by its values. The examples of tag usage ($Name, $Age) are shown in Fig. 34. In this case after report generation patient's name appears instead of $Name tag and patient's age appears instead of $Age tag. To look though the list of all available tags, press

**[Ctrl+Space]** key combination or  button on the toolbar (Fig. 35) while editing the template. Please, pay attention to the fact that the text replacing the tag will be of the same style (size, typeface, bold letters, etc.) as the tag itself.
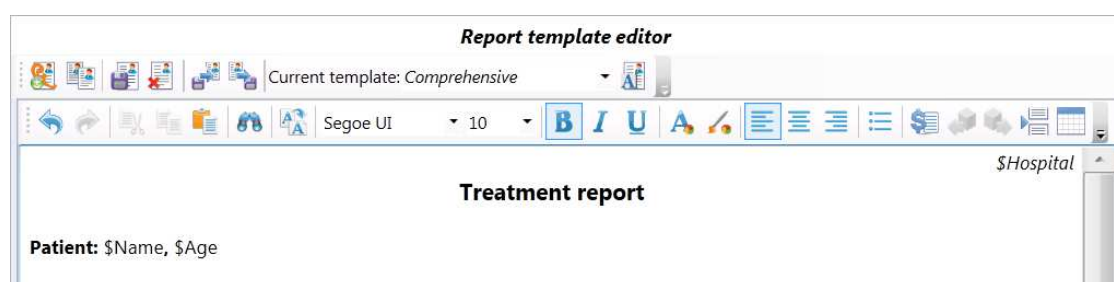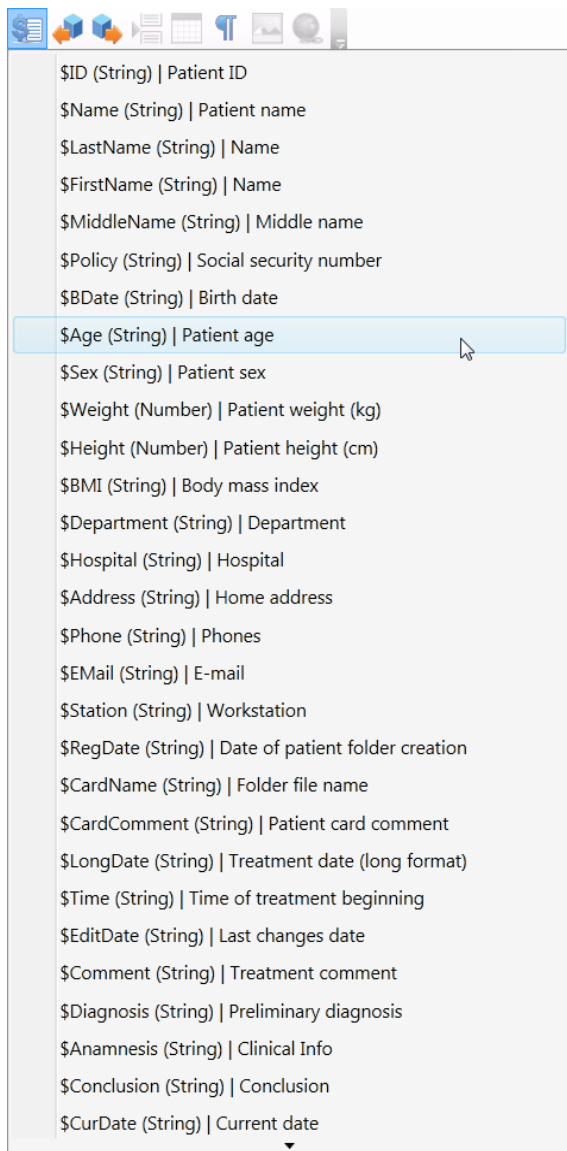


Fig. 34. Tag usage.

Fig. 35. List of available tags.

To format the template text, use corresponding buttons (they are standard for most text editors) located over the editor. Also among these buttons you can find the following ones: the ![icon] button to insert the table-container to the template, the ![icon] button to insert the image from file, the buttons to move the selected fragment one position forward ![icon] and backward ![icon]. Besides you can copy, insert, insert image from file and insert table-container using the context menu of the editor.

The right part of the editor contains the settings (properties) panel of the current report element. Each element has its own settings, using them you can change the appearance of the information included in the report. The default settings of the editor itself are shown in Fig. 36.

Fig. 36. Template editor settings.

The user tags could be created by report template developer. These tags as already mentioned ones can be inserted to any part of treatment report. However their real values are requested from a user during the generation of treatment report. Let us see the example.

Suppose that it is required to add the information about a patient's temperament type to the report. There are no such data in the treatment features and usually doctors have no wish to enter data to the report manually (it is easy to forget about). In this case you can apply user tags. As soon as you press Create... button (Fig. 36), the following dialog box appears on the screen (Fig. 37).
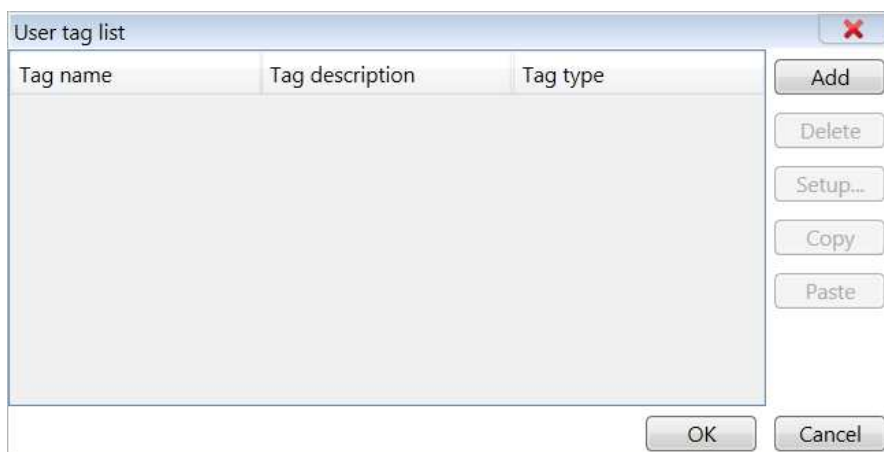


Fig. 37. The list of user tags.

Press Add button, specify "$Temperament" tag name, enter "Temperament" tag description and select "List" tag type (Fig. 38).
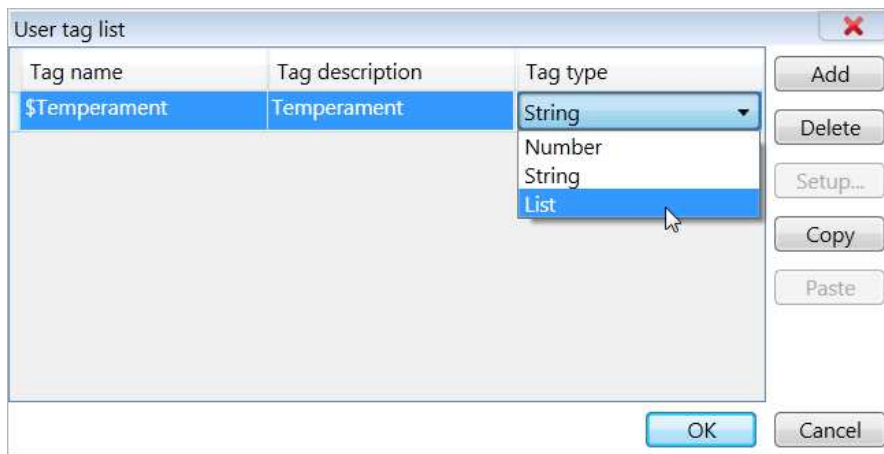
Fig. 38. Type of user tag.

In the appeared "User tag setup" window (Fig. 39) create the list of four temperament types.
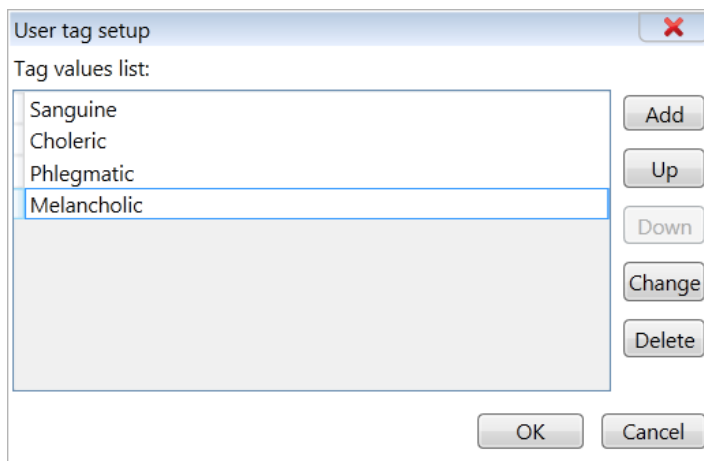


Fig. 39. User tag setup.

When you close these dialog boxes, the editor settings (Fig. 36) will change the following way (Fig. 40). Besides, the new "$Temperament" tag will appear in the list of available tags activated by means of **[Ctrl+Space]** key combination or by pressing the

 button.



Fig. 40. Template editor settings.

Now this tag can be used in the report template, for example, this way (Fig. 41).
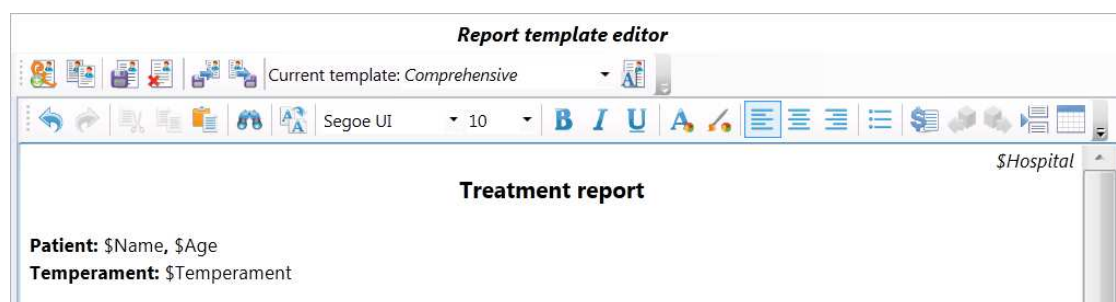


Fig. 41. User tag usage.

While generating the treatment report the dialog box shown in Fig. 42 will appear on the screen. Here you should select the patient temperament.
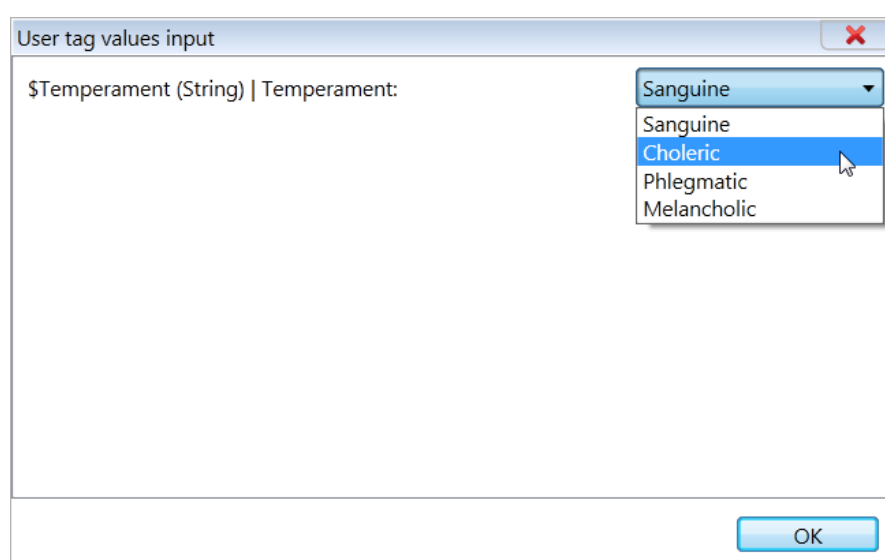


Fig. 42. Input of user tag values.

The report is shown in Fig. 43.



Fig. 43. Built-in report with data about patient temperament.

Let us rewiev several main elements (blocks) that can be used to create the report template.

## 2.17.1. Patient Photo

To add patient photo to report template, select the "Patient photo" element (at the left part of the screen) using left mouse button (Fig. 44). Then position patient photo at the editor template with the left mouse button (Fig. 45). The settings of "Patient photo" element will appear at the right part of the window (Fig. 46). Using this window you can adjust the element appearance.
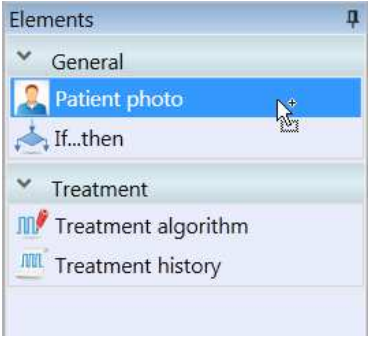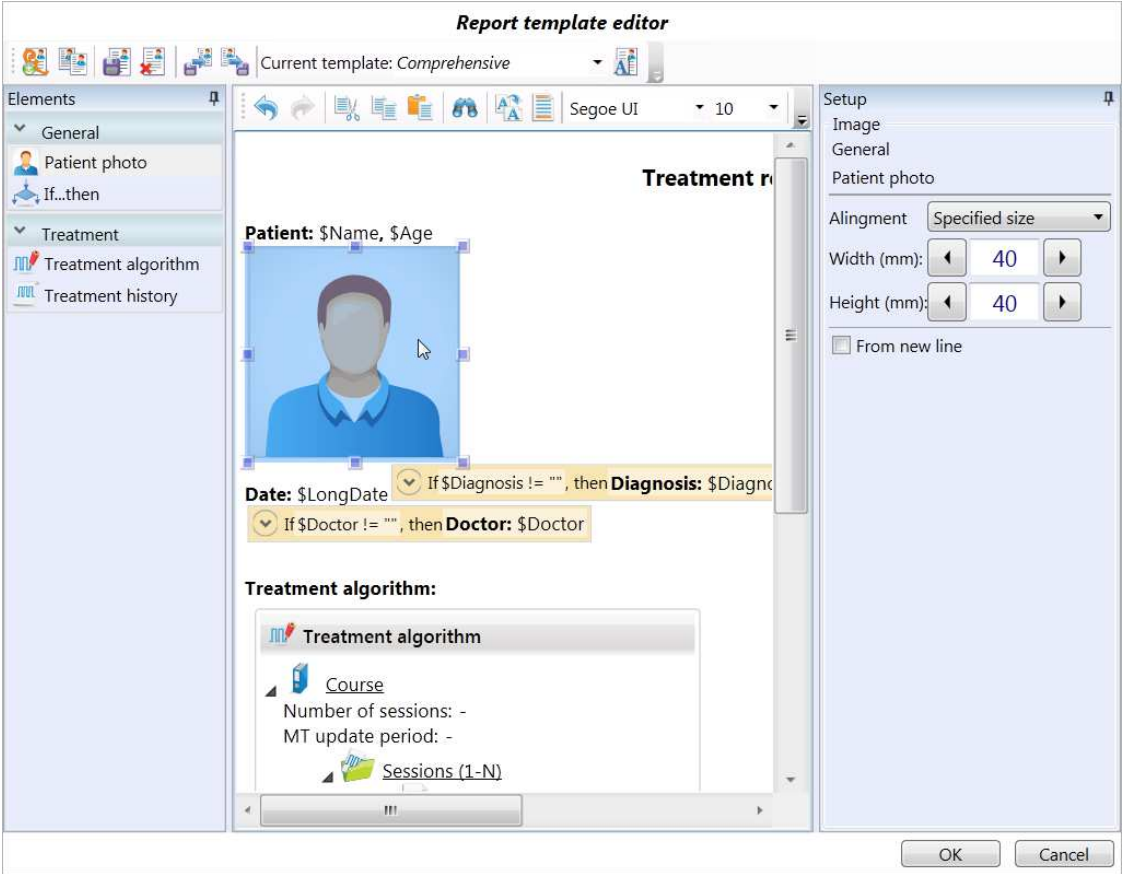
Fig. 44. Selection of "Patient photo" element.



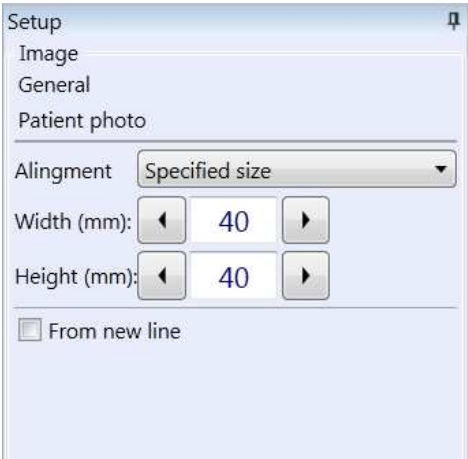Fig. 45. Insertion of "Patient photo" element.



Fig. 46. Setup of "Patient photo" element.

On report generation, the patient photo symbol (Fig. 45) will be replaced by real patient photo.

## 2.17.2. Treatment Algorithm

To add the information about treatment algorithm to the report template, click on "Treatment algorithms" element located at the left part of the page with the left mouse button (Fig. 47) and then click on the place of possible element location at the editor template with the left mouse button (Fig. 48). The settings of "Treatment algorithm" element will appear at the right part of the window (Fig. 49).
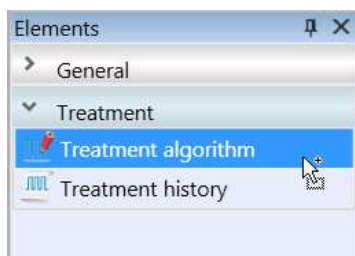


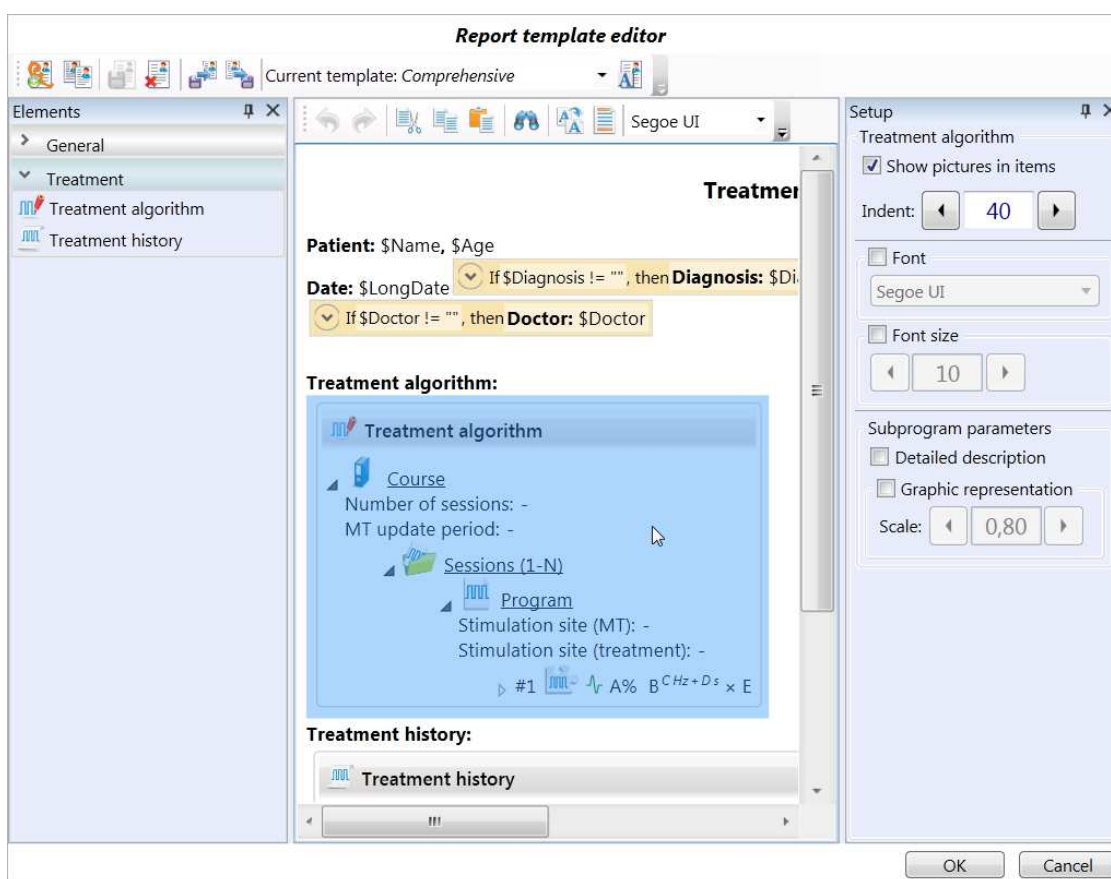Fig. 47. Selection of "Treatment algorithm" element.
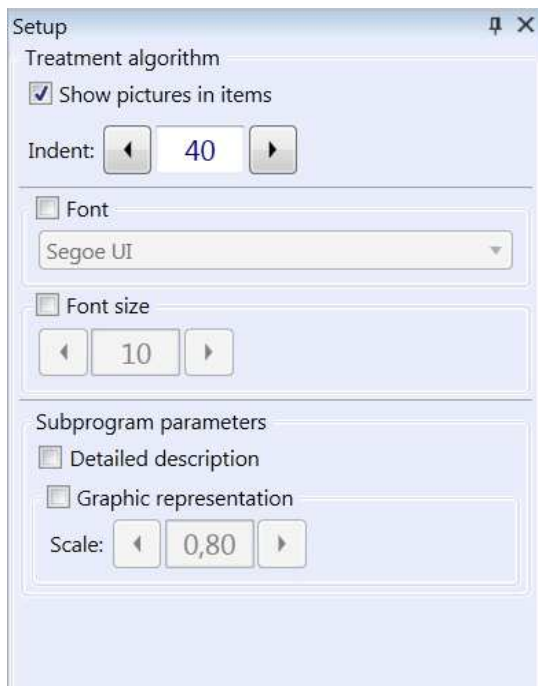


Fig. 48. Insertion of "Treatment algorithm" element.

Fig. 49. Treatment algorithm setup.

During the report generation the treatment algorithm icon (Fig. 48) will be replaced with tree structure describing treatment algorithm on the base of actual data.

## 2.17.3. Treatment History

To add the information about treatment history to report template, select the "Treatment history" element (in the left part of the screen) using left mouse button (Fig. 50), and then click on the place of possible element location at the editor template with the left mouse button (Fig. 51). The settings of "Treatment algorithm" element will appear at the right part of the window (Fig. 52). Using this window you can adjust the element appearance:

- General — general settings.

- M-wave analysis — settings for M-wave analysis traces and/or tables presentation.

To add the information about treatment history to the report template, click on "Treatment history" element located at the left part of the page with the left mouse button (Fig. 50) and then click on the place of possible element location at the editor template with the left mouse button (Fig. 51). The "Treatment history" element settings will appear at the right part of the window (Fig. 52).
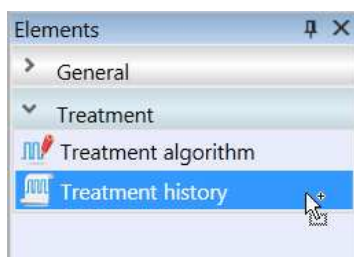


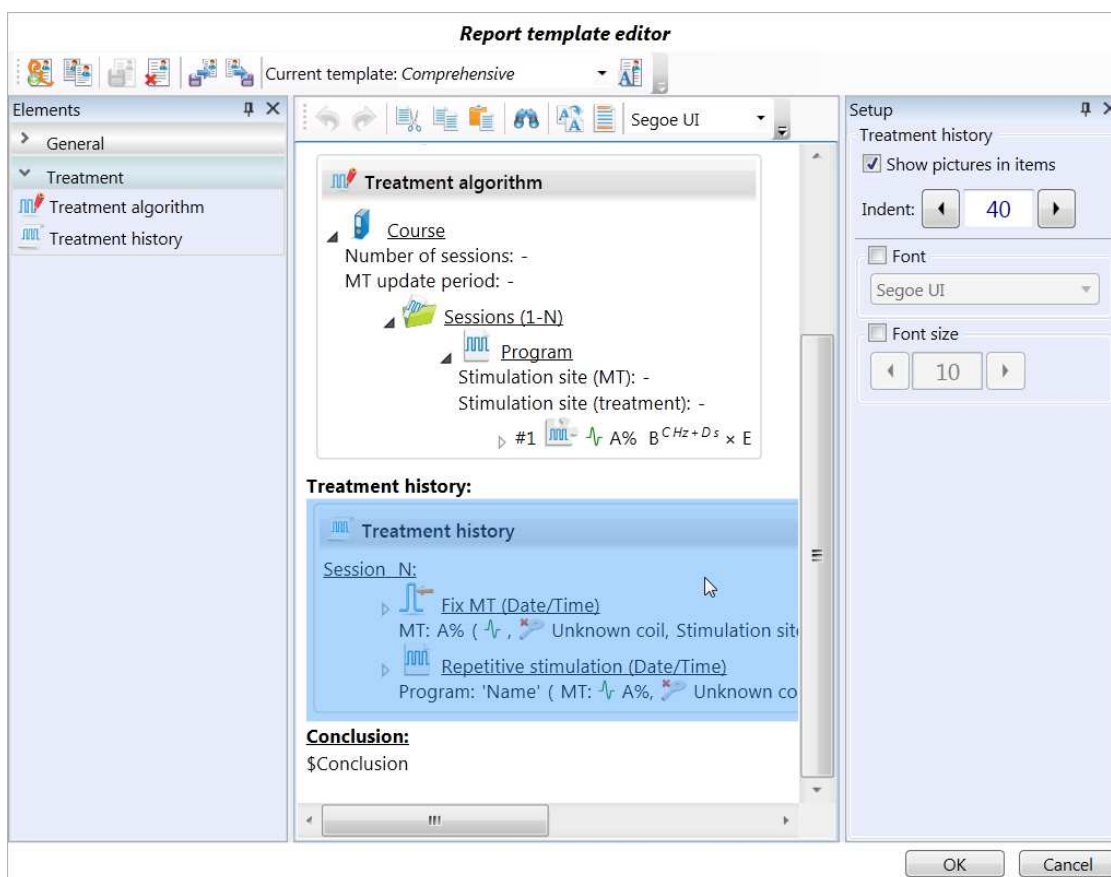Fig. 50. Selection of "Treatment history" element.

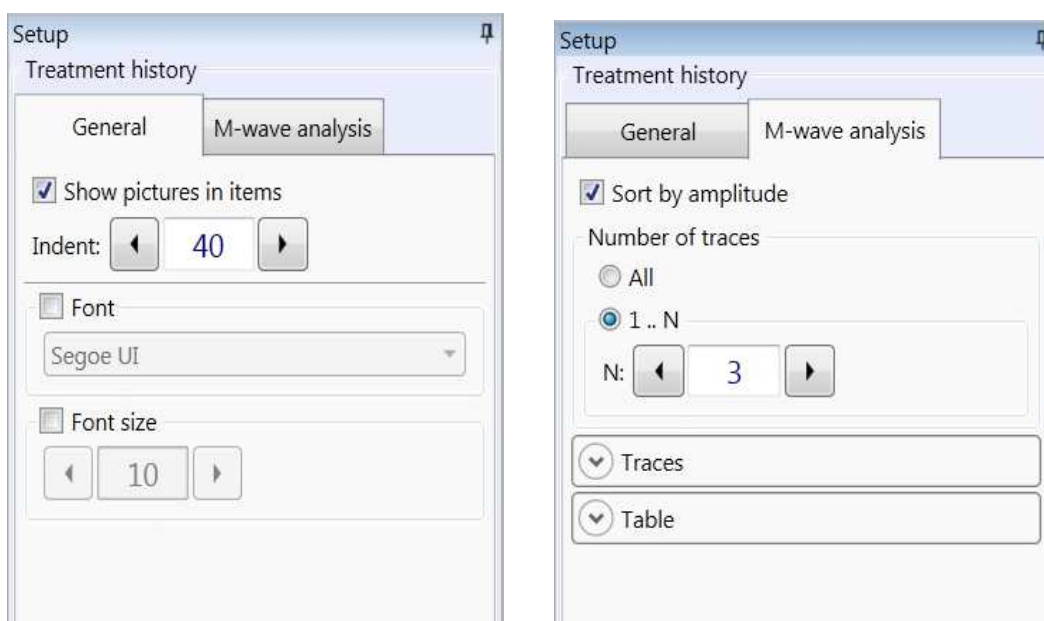Fig. 51. Insertion of "Treatment history" element.



Fig. 52. Treatment history settings.

During the report generation the treatment history icon (Fig. 51) will be replaced with list of events saved in the treatment history.

## 2.17.4. "If…then" Conditional Element

Sometimes you have to include some information to the report depending on some conditions. For example if the patient is diagnosed (the corresponding information is

entered), then the diagnosis can be included to the report; else it has no sense to include this information into the report. In this case the special conditional elements "If... then" can be used. These elements allow to include some data in the report if one condition is fulfilled and include another information (or do not include any information) in the report if the condition is not fulfilled.

To add the conditional element to the report template, click on "If…then" element located in the left part with the left mouse button (Fig. 53) and then click on the place of possible element location at the editor template with the left mouse button (Fig. 54). The element settings (Fig. 55) will appear at the right part of the window.
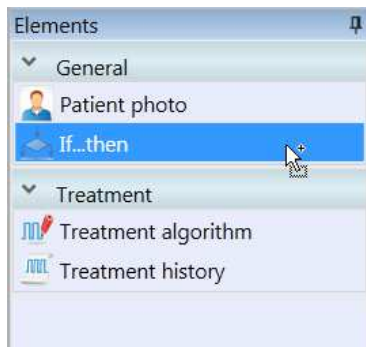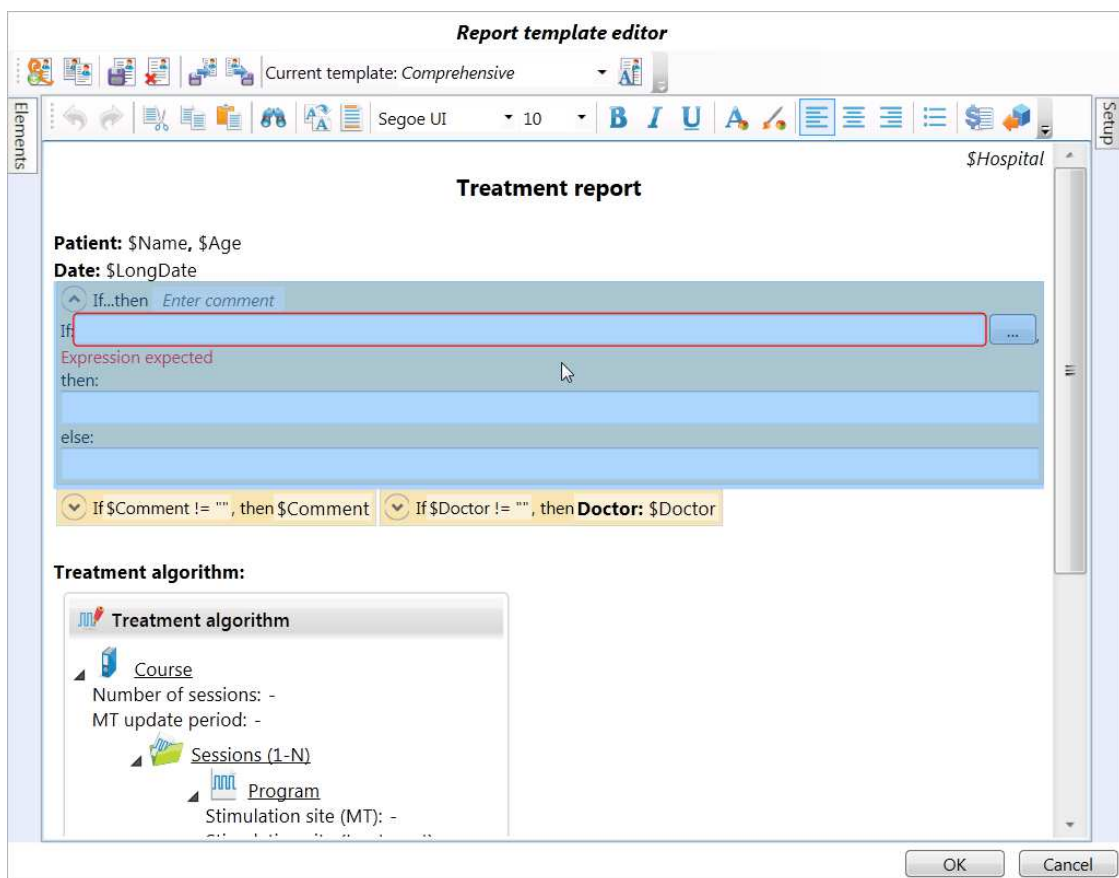


Fig. 53. Selection of "If…then" element.
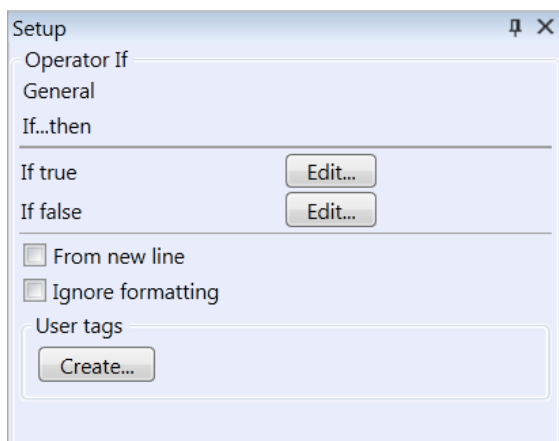


Fig. 54. Insertion of "If…then" element.

Fig. 55. "If…then" element settings.

Let us consider the above-mentioned example concerning the information about diagnosis (Fig. 56).



Fig. 56. Parameters of "If…then" element.

If the information about diagnosis is entered ($Diagnosis tag), the "Diagnosis: **[information about diagnosis]**" text will be added to the report, else the report will not contain this information. Let us consider the "If $Diagnosis != "", then" string in more detail. It should be read as: if diagnosis ($Diagnosis) is not equal to (!=) an empty string (""), i.e. not empty, then…. To read a tip on generation of such logical expressions, press the [...] button (Fig. 56).

The elemen can contain not only text, but any other elements.

## 2.17.5. Table-container

The table-container allows formatting the information in the report by strings and columns. Using it, you can display any information side-by-side.

To add the table-container to the report template, click on the [⊞] icon located on the toolbar with the left mouse button or select "Insert table-container" menu command in the local menu (Fig. 57). After that the table-container will appear on the template editor at the text cursor position (Fig. 58). The element settings will appear at the right part of the window (Fig. 59).
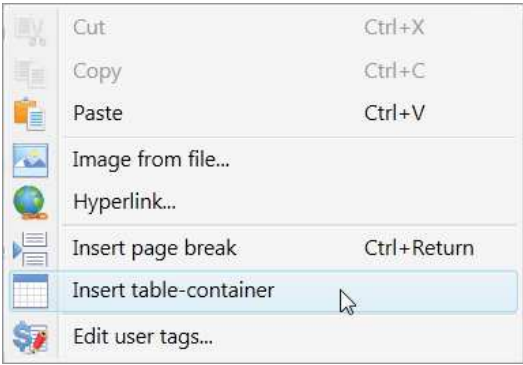
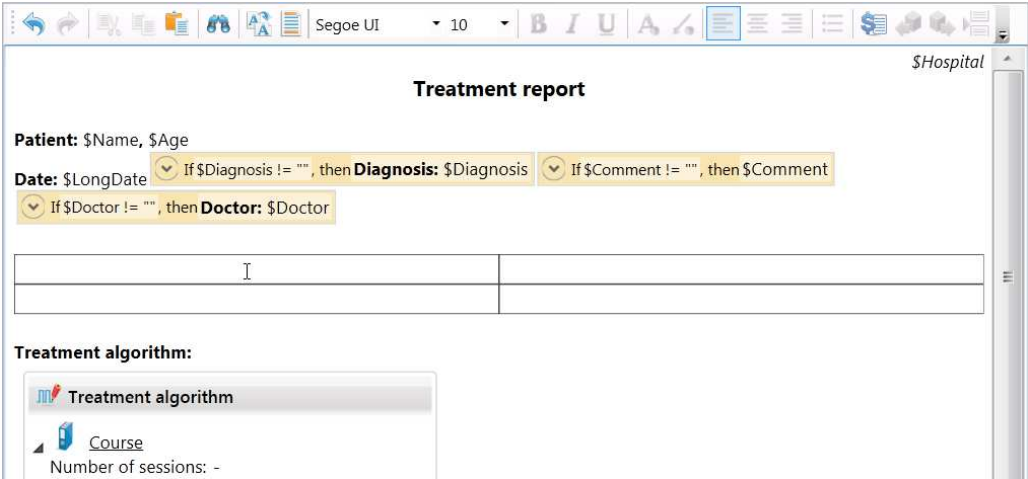Fig. 57. Selection of "Insert table-container" element.



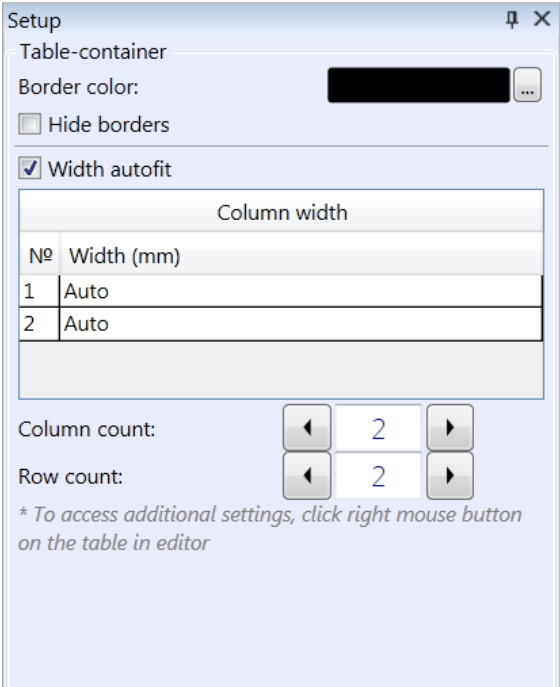Fig. 58. Insertion of table-container.



Fig. 59. Table-container settings.

# 2.18. Hardware and Sorftware Configuration Settings

The setting of program basic parameters is carried out by the **Setup|Change** menu command.

"General" page (Fig. 60)*.*



Fig. 60. "General" page.

"User"*.*

*"*Login". The user name to login. Each user has his/her own settings (e.g., the possibility to change toolbar settings, to connect databases, etc.), which does not influence the settings of any other user. To change a user or to add a new one, press Change button. After that the program will be restarted.

*"*Password". A password required at each program start. Keep in mind that it will be impossible to restore the password in case you forget it. You can leave this field empty (log on without password).

*"*Request login and password". If the checkbox is checked, user login and password will be required after the program startup.

"Protect settings with password:" If the checkbox is checked, you are allowed to change the program settings only after the password entering.

"Hospital" – a name of medical establishment indicated in the treatment report ($Hospital tag value).

"Program start". Action carried out automatically after the program startup.

"After closing of treatment". Action carried out automatically after the treatment closing.

"Database. Use data compression for archiving". You can compress data to save the space on a disk but it can slows down the operation with archives.

"Maximum number of opened treatments". Limit of treatment number to be opened simultaneously.

"Software" page (Fig. 61).



Fig. 61. "Software" setting page.

"Single pulse mode" group box.

"Initial stimulus amplitude, %" field allows to change the initial stimulation amplitude to be applied at the creation of new treatment.

"Next stimulus delay, s" field allows to change the delay of the next stimulus delivery.

"Saving of traces at MT fixation" option allows choosing the criterion of trace saving to stimulation history at MT fixation.

If the "Automatically move to repetitive stimulation mode after fixation of all MT" check box is marked the software after fixation of last MT will go to repetitive stimulation mode automatically (only if all MT values are detected and valid).

If the "Possibility to set M-wave search range" checkbox is marked, the [M] button appears in "Single pulse mode" window. Use this button to set the M-wave search range by time, duration and amplitude.

"Trace review" group box helps to setup the appearance of acquisition window, the actions with traces at signal acquisition, marker names and visibility.

"Placebo-controlled trial" — placebo-controlled trial setup.

"Default treatment report". Binding of **Report|New report 1** and **Report|New report 2** menu commands with the certain report templates. In the example (Fig. 61), the treatment report will be generated according to "Comprehensive" template if **Report|New report 1** menu command is selected.

"Autosave on new treatment". If the checkbox is checked, the **Treatment|Save** command is executed automatically after the new treatment creation.

"Open clinical info in new treatment". If the corresponding checkbox is checked, the window to enter patient's clinical information is opened just after a new treatment creation.
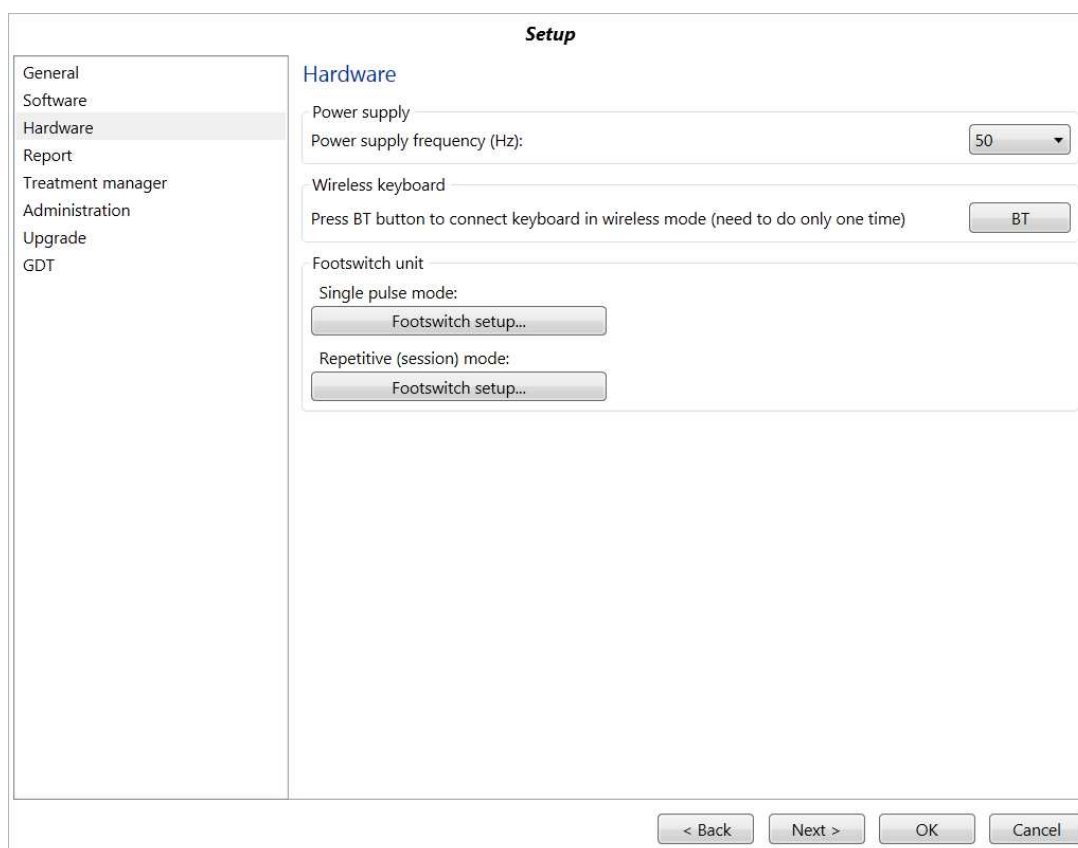
"Hardware" page (Fig. 62).



Fig. 62. "Hardware" setting page.

*"*Power supply. Power supply frequency (Hz)". Electric mains frequency in your region in Hz for the notch filter settings. In Russia and Europe this value equals to 50 Hz, in USA – 60 Hz.

"Wireless keyboard". Button for Bluetooth-keyboard connection via wireless bluetooth interface. Press the button once when you connect the wireless keyboard to your computer for the first time. If the Bluetooth-keyboard is connected through USB port, it will function without pressing this button.

"Footswitch unit". Press "Footswitch setup…" button to establish relations between footswitch pedals and menu commands. Footswitch unit customization is executed separately for single pulse mode and repetitive stimulation mode.

"Report" page (Fig. 63).



Fig. 63. "Report" setting page.

"Show "New report" dialog". If the checkbox is checked, the dialog box with a query for report name and comment will be displayed before creating a new treatment report.

"Show glossary with report". If the corresponding checkbox is checked, the glossary window will be displayed each time you open a treatment report.

"Copy reports to the folder". If the corresponding checkbox is checked, the treatment reports are simultaneously copied to the indicated folder on the computer disk when you save the treatment.

"Report name template". The file name template for the treatment report. In this template you can use the same tags as in the treatment report. It allows making the file name clearer. For example, in this case ("$NAME_$ID_$SHORTDATE_$TIME") the file name will consist of a patient's name, an ID, date and time of treatment creation.

"Font". The default font of the treatment report. The same font is used by default in "Clinical info" and "Conclusion" windows.

"The [Report templates...] button". Changing of the treatment report templates.

"Treatment manager" page (Fig. 64).
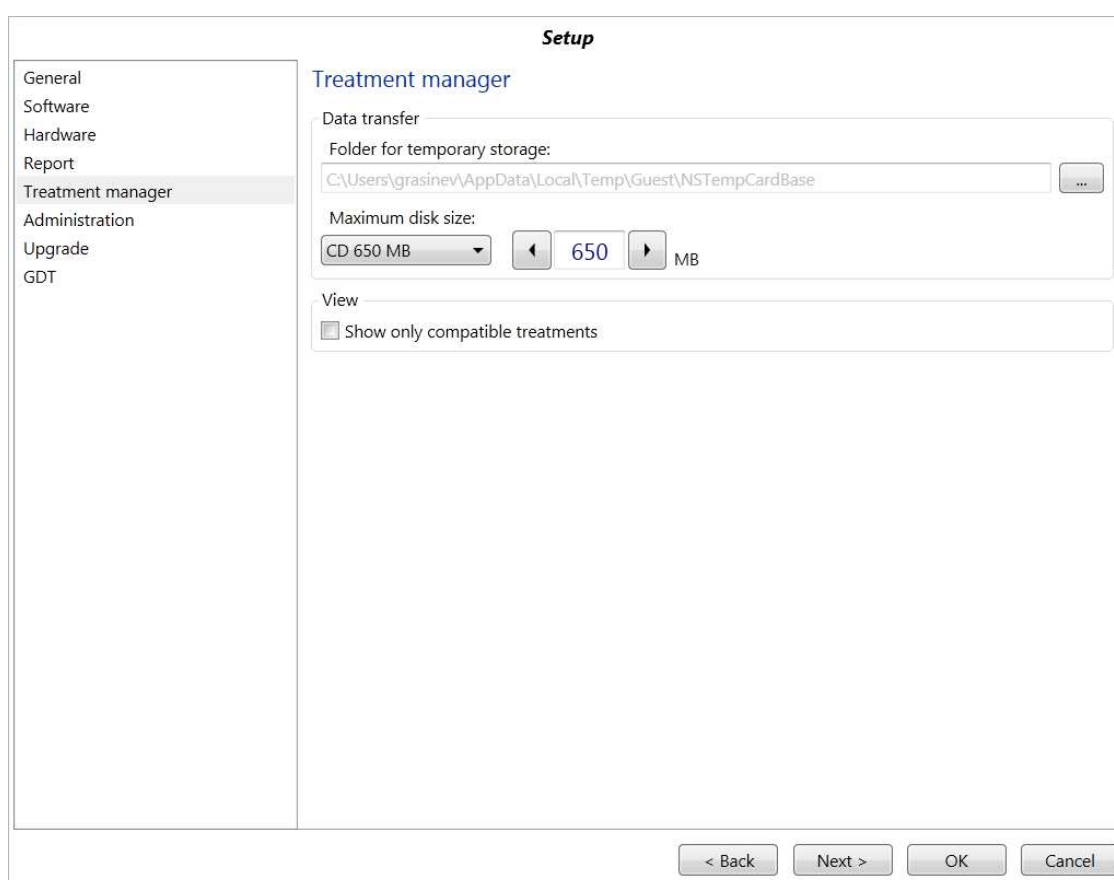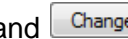


Fig. 64. "Treatment manager" setting page.

"Data transfer". Folder for temporary storage". The folder for temporary storage of data transferred from database to CD. The data are stored in the folder till the folder size achieves the maximum possible size to burn it on CD.

"Maximum disk size". The size of compact disk used for the treatment storage. The size can be selected from the combo-box and set arbitrary.

"View. Show only compatible treatments". If the checkbox is checked, the "Treatment Manager" will display only those treatments that can be reviewed (opened) with this program.

"Administration" page (Fig. 65).



Fig. 65. "Administration" setting page.

"Users". The list of users. [Add...], [Delete] and [Change...] buttons are intended to edit the list of users.

"Workstation name". The name of network station (computer) in case of operation with network database.

"Patient and treatment data". Customization of patient's card appearance, requested at the beginning of each new treatment. It is necessary to check the checkboxes opposite those fields which should be included in the dialog box.

"Additional parameters…". Customization of additional (user) parameters introduced in patient card.

"Default patient sex". This element allows to specify the patient' sex by default at the beginning of each treatment.

"Validate input data". If the checkbox is checked, the check of availability of entered patient name, sex, age and weight is carried out at the beginning of each new treatment before the patient card closing.

"Upgrade" page (Fig. 66).



Fig. 66. "Upgrade" setting page.

"Turn on autoupgrade". If the checkbox is checked, the program is updated automatically. The program checks the presense of new program version in the specified folder on each program start and, if it is available, updates automatically.

"Software upgrade settings". Choose the variant of software upgrade using radio buttons located in this group box.

"GDT" page (Fig. 67).



Fig. 67. "GDT" setting page.

The folder names with input and output data to synchronize the treatments and GDT integration protocol of a hospital are entered on this page.

# 2.19. Toolbar

The toolbars with buttons are intended to speed up an access to some menu commands. The program has flexible system of toolbar setup. This system allows customizing toolbars and assigning "hotkeys" to the menu commands. Besides, you can drag the toolbars with the mouse and position them at any convenient place along the perimeter of main program window.

To set up the toolbar, click the right mouse button on it and select "**Setup…"** local menu command (Fig. 68). After that "Toolbar setup" window (Fig. 69) will appear on the screen.
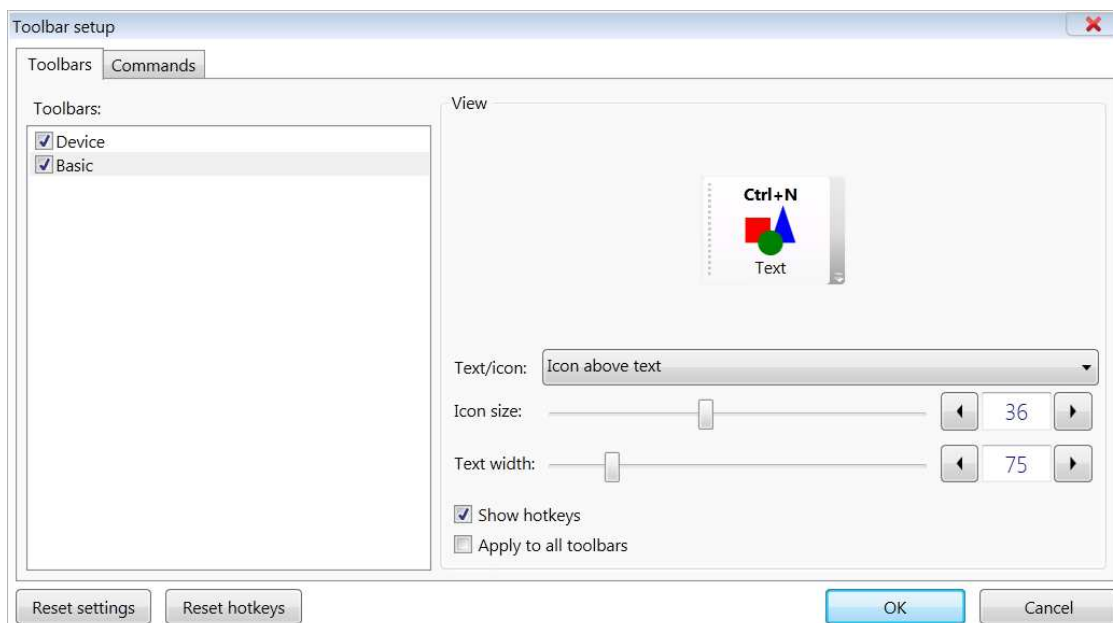


Fig. 68. Toolbar setup local menu.

Fig. 69. "Toolbar setup" window. "Toolbars" page.

Using this window you can setup the toolbar appearance: text/ icon ratio, icon size, text width, hotkeys if they are required.

The "Commands" tab of "Toolbar setup" window (Fig. 70) allows customizing the information panels. In this window you can see all menu commands available in this context (i.e. when "Toolbar setup" window is opened). Any of these commands can be added to any toolbar as a button.
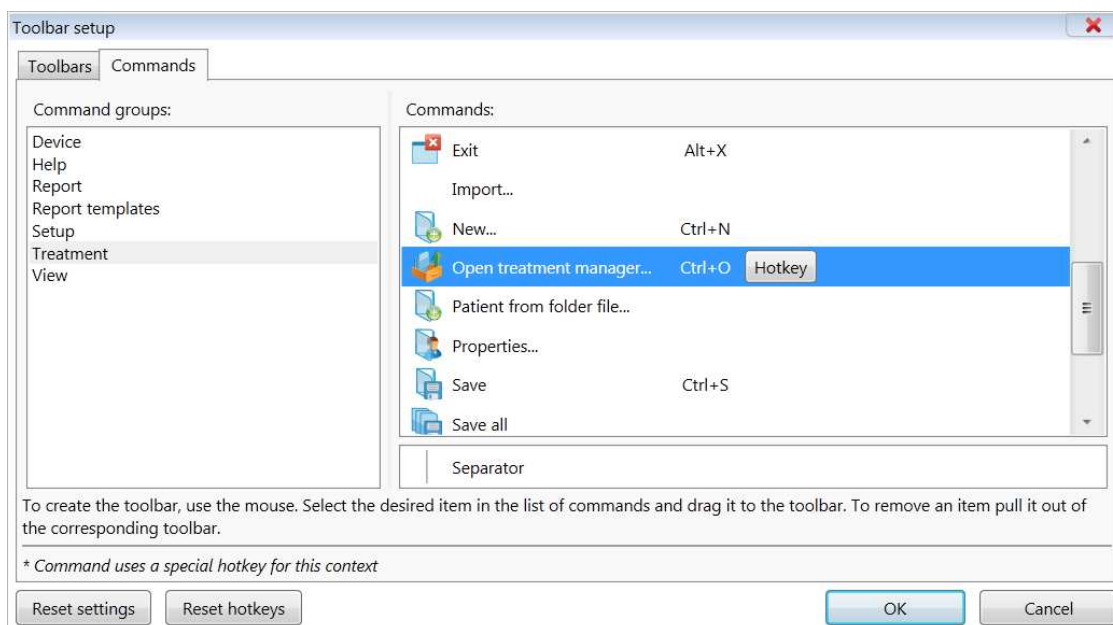


Fig. 70. "Toolbar setup" window. "Commands" page.

To add the button to the toolbar, select the required element from the list of commands and drag it with the mouse to any place of any toolbar. Besides in this mode you can drag the available buttons between the toolbars, remove them from the toolbars by pulling them out of the toolbars boundaries.

To assign the new hotkeys for the commands, use Hotkey button.

# 2.20. Amplifier Settings

To customize amplifier settings (number of channels, filter parameters etc.) for all allowed amplifiers, use **Setup|Amplifiers…** menu command. The program will display "Amplifier settings (by default)" window (Fig. 71).
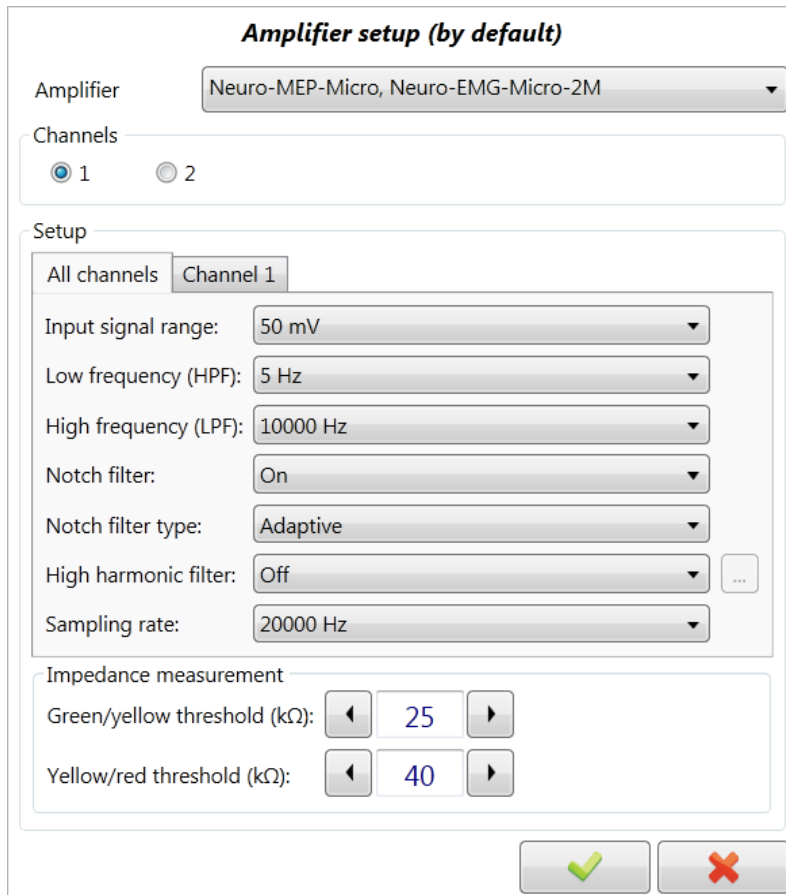


Fig. 71. "Amplifier settings (by default)".

"Amplifier" — the amplifier type.

"Channels" — the amplifier channel which will be used for signal acquisition.

"Input signal range"". Maximal signal range at the amplifier input which is received by the device without distortions. The input range should be 2-3 times higher than the maximum possible expected signal obtained from the patient. Too high values of input signal increase noise level and too low values lead to amplifer saturation and signal distortions.

"Low frequency (HPF)". Low cutoff frequency (high pass filter).

"High frequency (LPF)". High cutoff frequency (low pass filter).

"Notch filter". Notch filter state (50 or 60 Hz).

"Notch filter type". *Recursive* notch filter has high suppression ratio but it can lead to the distortion of high-amplitude responses, so it is recommended to be used in the acquisition without stimulation. *Adaptive* notch filter has low suppression ratio, it does not lead to the responses distortion and can be used in the acquisition with stimulation.
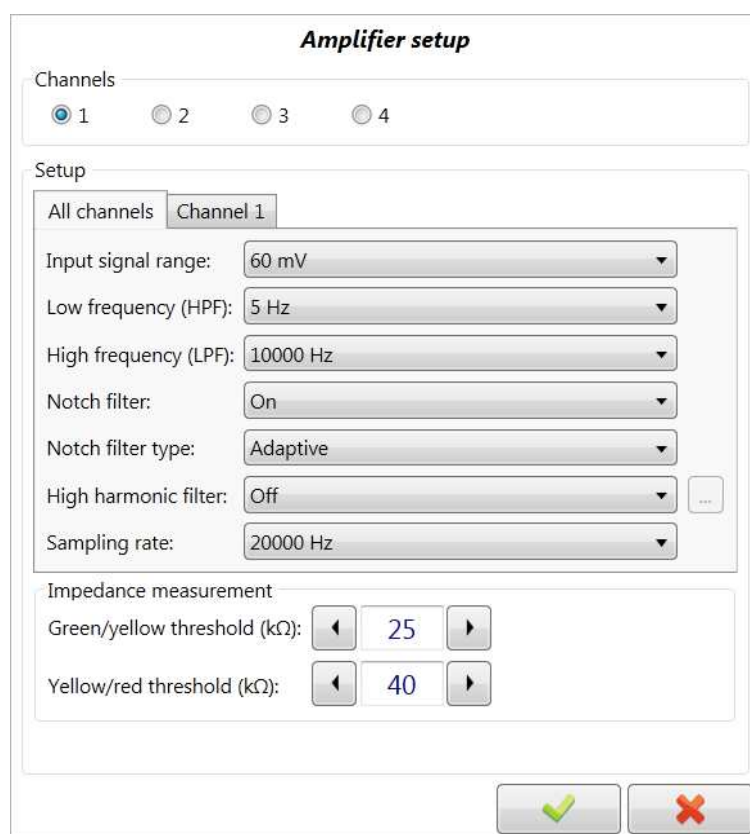
"High harmonic filter". Adaptive high harmonic filter is useful when the interference level is considerable at high-frequencies.

"Sampling rate". A/D converter sampling frequency.

"Impedance measurement". Green/yellow/red thresholds are set to control the quality of electrodes placement using impedance color imaging.

To customize amplifier settings during the treatment use **Hardware|Amplifier setup** menu command or [ ] toolbar button. Customize amplifier settings in the window that appears (Fig. 72).



Fig. 72. Amplifier setup.

# 3.   Treatment Templates

The program offers two operation modes: "Course" and "Programs". "Course" mode - the main treatment mode formed on the basis of medical protocol. This mode implies several procedures. "Programs" mode is the special treatment mode. It allows performing stimulation on one or more programs and implies only one procedure.

To systematize the doctor's work, to facilitate treatment template creation and treatment performing, **Neuro-MS.NET** contains course templates and program templates. To unify recording site names and stimulation site names, the program contains corresponding lists.

To edit mentioned lists and templates, choose the corresponding command in **Setup|Treatment templates** menu.

Formed lists of recording sites, stimulation sites, program and course templates can be exported selectively to external file using **Setup|Treatment templates|Export…** menu command. To import settings use **Setup|Treatment templates|Import…** menu command.

## 3.1. Recording Sites

To edit the list of recording sites use **Recording sites…** command in the menu **Setup|Treatment templates**.

"Recording sites" page (Fig. 67) has two parts. At the left part of the page the list of recording sites is represented and at the right part of the page you can edit corresponding settings.

You can name each recording site, add a comment and set the content of help window.

To change the content of help window, click on the ![pencil button] button.

Using control buttons located at the bottom of the page you can perform following actions:

- ![plus button] — add new recording site;

- ![minus button] — delete the selected recording site;

- ![up arrow button] — move the selected recording site one position higher;

- ![down arrow button] — move the selected recording site one position below;

To save settings press [✓] button and to cancel the operation press [✗] button.



Fig. 73. "Recording sites" page.

# 3.2. Stimulation Sites

To edit the list of stimulation sites use **Stimulation sites…** command in the **Setup|Treatment templates** menu.
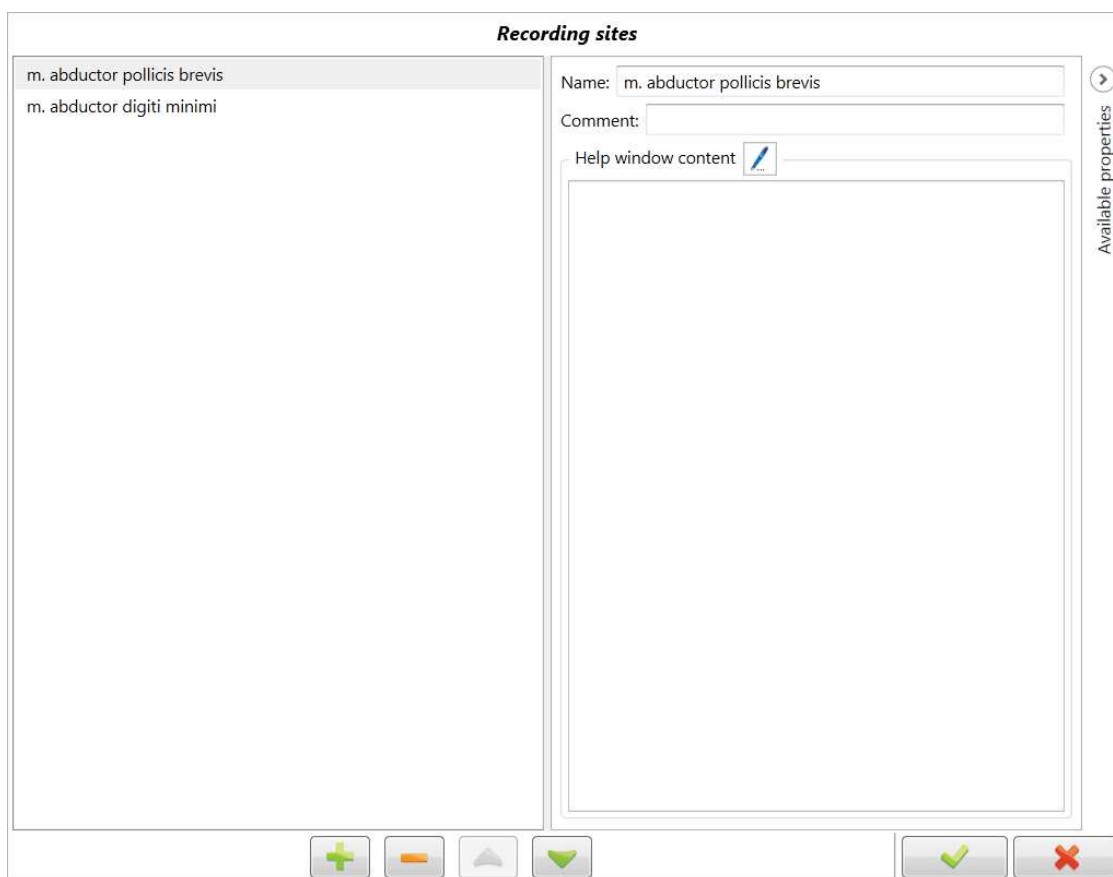
"Stimulation sites" page (Fig. 74) has two parts. At the left part of the page the list of stimulation sites is represented and at the right part of the page you can edit corresponding settings.

You can name each stimulation site, add a comment and set a content of help window. If the stimulation site will be used to detect motor threshold, you can set a list of corresponding recording sites. Recording sites for this list will be set on the bases of preformed recording site list (see "Recording Sites" chapter) and will be ordered according to usage priority.

To change the content of help window, click on the [✎] button.

Using control buttons located at the bottom of the page you can perform following actions:

- [+] — add new stimulation site;

-  — delete the selected stimulation site;

-  — move the selected stimulation site one position higher;

-  — move the selected stimulation site one position below.
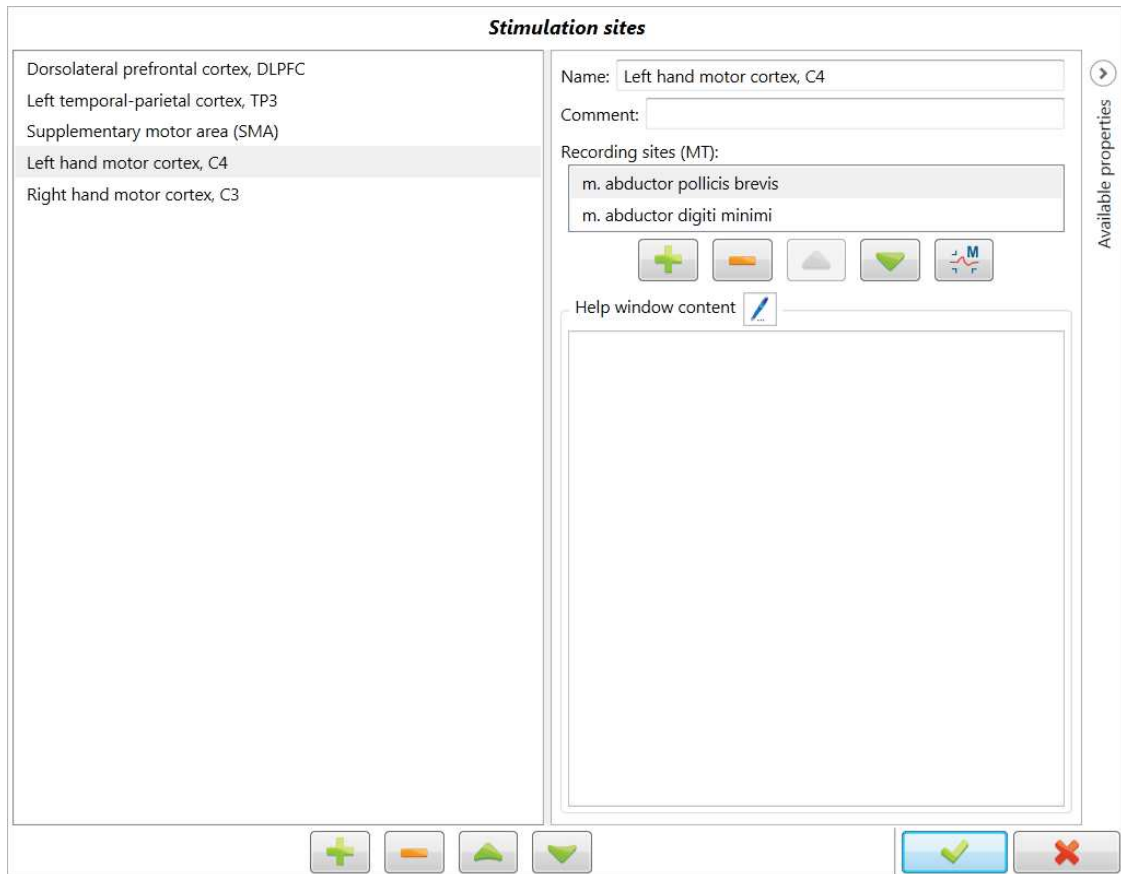


Fig. 74. The list of stimulation sites.

The analogous buttons located in the setup area are used for recording site list forming. The  button allows setting the range of M-wave search for the current stimulation site and selected recording site. Keep in mind that by default the M-wave search is performed by the whole trace. To activate the possibility to set M-wave search range, mark the "Possibility to set M-wave search range" checkbox (see chapter 2.18 "Hardware and Sorftware Configuration Settings", "Software" tab, "Single pulse mode" group box).

To save settings press  button and to cancel the operation press  button.

# 3.3. Program Templates

To edit the program templates use **Program templates…** command in the menu **Setup|Treatment templates**.

"Program templates setup" page (Fig. 75) has two parts. The left part contains the tree list of programs devided into groups and at the right part of the page you can edit corresponding settings.

"Group of programs" element [icon] contains programs grouped on the bases of common feature. Editable properties are name and comment.

"Program" element [icon] contains the list of stimulation subprograms organized in such a way to be executed in consecutive order. Stimulation program can include one subprogram (simple stimulation program) or several subprograms (complex stimulation program). Editable properties are name, comment, stimulation site for MT detection and stimulation site for performing the treatment (Fig. 75). Two last parameters will be set on the bases of preformed stimulation site list (see "Stimulation Sites" chapter). Also you can set the side of stimulation for each stimulation site.
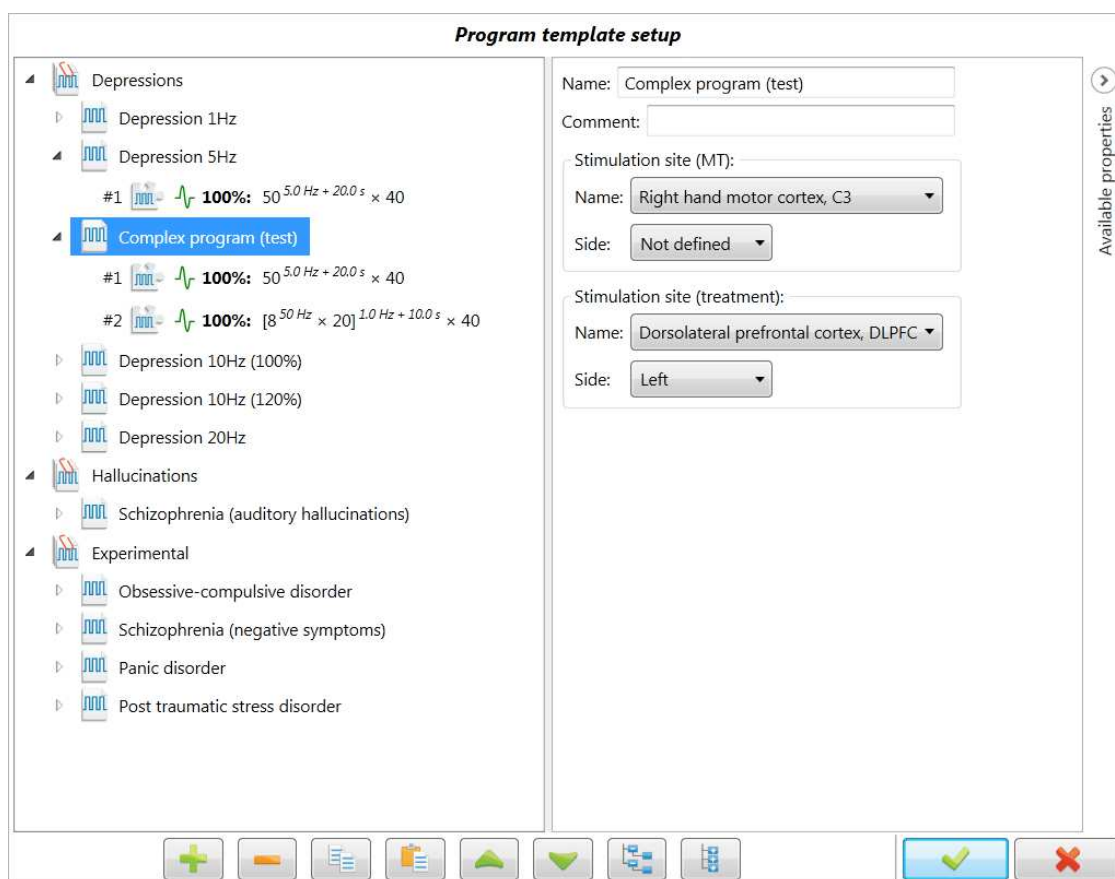


Fig. 75. Program templates. "Program" element.

"Subprogram" element [icon] contains basic parameters for repetitive stimulation (right part of the page on Fig. 76). Editable properties:

- Stimulation type: biphasic, monophasic or burst.

- Absolute amplitude, % — stimulation amplitude in case if motor threshold (MT) is not detected.

- Relative amplitude, % — stimulation amplitude depending on motor threshold (MT) value.

- Pulses (bursts) frequency in train, Hz.

- Pulses frequency in burst, Hz.

- Pulses (bursts) in train.

- Pulses in burst.

- Number of trains.

- Pause between trains, s.

- Waiting time, s — time to the next subprogram.
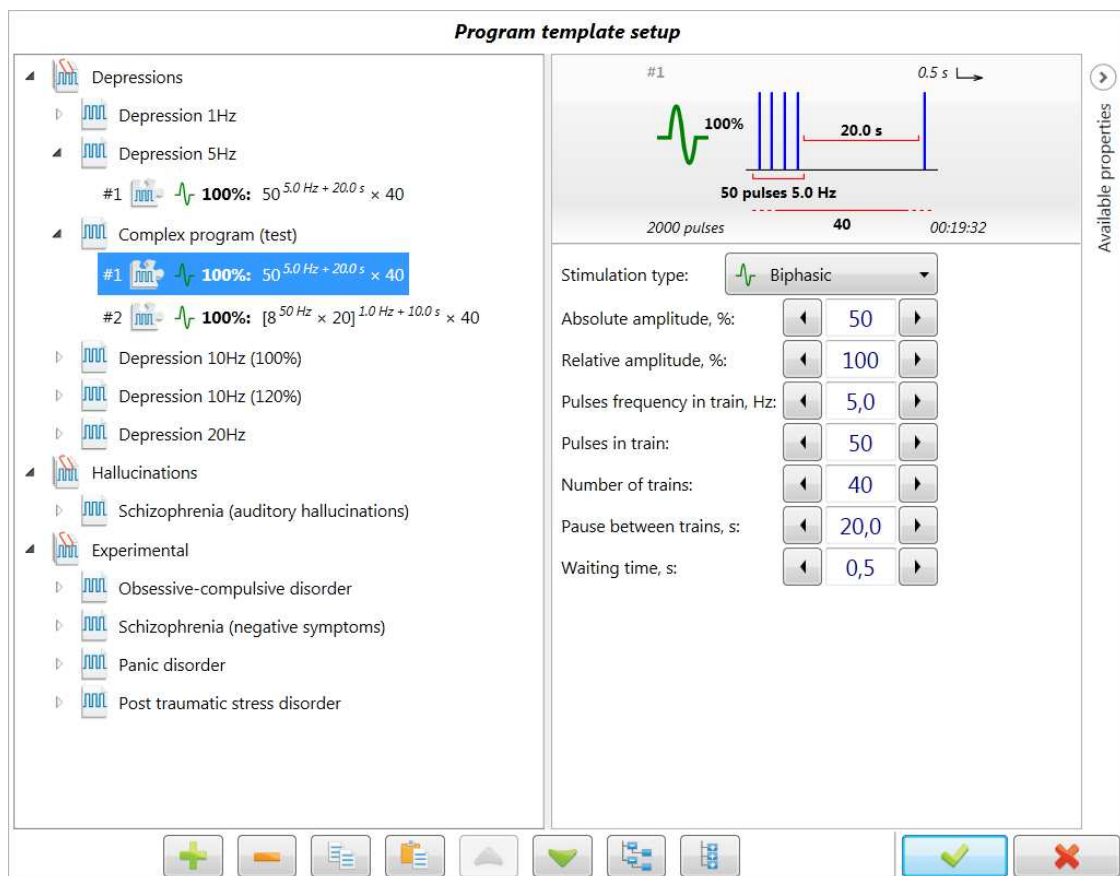


Fig. 76. Program templates. "Subprogram" element.

The ranges of the admissible stimulation parameters you can find in the chapter 4.2 " Stimulation Parameters". However, the variation ranges of some parameters depend on current values of related parameters. For example, the variation range of "Pulses in burst" parameter is from 2 up to 10, but its maximal value depends on "Pulses frequency in burst" and "Bursts frequency in train" parameters. For more convenience Neuro-MS.NET software displays messages with information about restrictions of parameter variation ranges (Fig. 77). It occurs when some parameters reach its boundary values when editing.
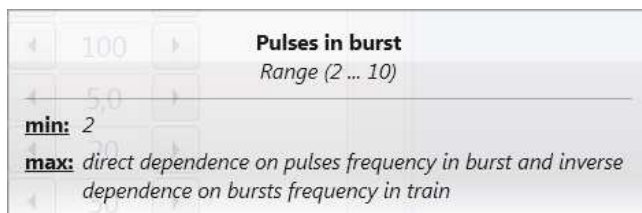
Fig. 77. The window with information about restrictions.

For the sake of simplicity all editable subprogram parameters are represented graphically (see "Basic Notions" chapter).

---

**Subprogram name is formed on the basis of its parameters. It helps to make record short and informative:**

▷ 〰 **100%: 50** $^{5,0\ Hz\ +\ 20,0\ s}$ **× 40**
Stimulation type: 〰 Biphasic (⌒ Monophasic)
Relative amplitude, %: 100
Pulses in train: 50
Pulses frequency in train, Hz: 5,0
Pause between trains, s: 20,0
Number of trains: 40

▷ 〰 **100%: [8** $^{50,0\ Hz}$ **× 20]** $^{1,0\ Hz\ +\ 10,0\ s}$ **× 40**
Stimulation type: 〰 Burst (designation: '**[**' '**]**')
Relative amplitude, %: 100
Pulses in burst: 8
Pulses frequency in burst, Hz: 50
Bursts in train: 20
Bursts frequency in train, Hz: 1,0
Pause between trains, s: 10,0
Number of trains: 40

---

Using control buttons located at the bottom of the page you can perform following actions:

- ➕ — add new group of programs, new program or new subprogram;

- ➖ — delete the selected element;

- 📋 — copy the selected element;

- 📋 — insert copied element;

- 🔼 — move the selected element one position higher;

- 🔽 — move the selected element one position below;

- 🗂 — expand all elements;

- 🗂 — collapse all elements;

To save settings press ⬜ button and to cancel the operation press ⬜ button.

# 3.4. Course Templates

To edit the course templates use **Course templates…** command in the **Setup|Treatment templates** menu.

"Course templates setup" page (Fig. 78) has two parts. The left part contains the tree view of cources devided into groups and at the right part of the page you can edit corresponding settings.

"Group of courses" element ⬜ contains courses grouped on the bases of common feature. Editable properties are name and comment.
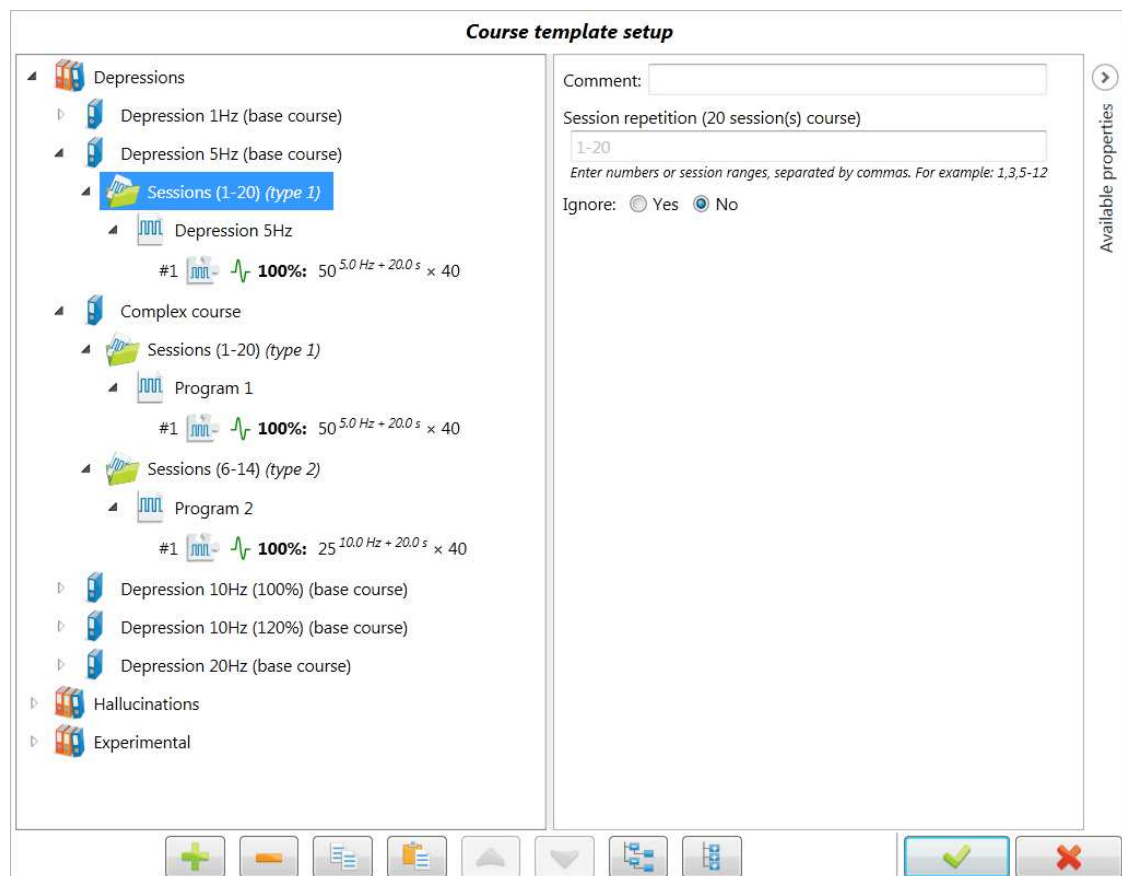


Fig. 78. "Course templates setup" page.

"Course" element ⬜ contains treatment session types and helps to create simple and complex treatment courses. In addition to course name and comment you can edit two following properties:

- "Number of sessions" — set the maximum number of sessions in the course. If this number is exceeded, the course will be considered executed.

- "MT update period" — is used to emphasise the currency of running MT value.

"Session type" element  describes treatment sessions which contain the same set of stimulation programs. The most important editable properties are:

• "Session repetition" — is used to set diapasons and/or numbers of sessions which contain the same set of stimulation programs. If the repeatability is not set, this session type will be used during the whole course.

• "Ignore" — is used to exclude temporarily the selected session type from course.

*You can see the example of complex treatment course ("Complex course") on Fig. 78. It implies 20 procedures and contains two session types. "Program 1" of the first session type will be performed each time and "Program 2" of the second session type – only from 6 to 14 procedure. So, from 6 to 14 procedures the treatment will be performed on two programs.*

"Prodram" and "Subprogram" element descriptions are analogous to given in "Program Templates" chapter.

 button at the bottom of the screen is used to add new group of courses, new course, new session type, new program or subprogram. Functionality of other buttons is analogous to one described in "Program Templates" chapter.

To save settings press  button and to cancel the operation press  button.

# 4.    Appendix

## 4.1. Work with Neuro-EMG-MS Digital System

**Neuro-EMG-MS** is a 2-channel digital system developed for the operation with the magnetic stimulators of **Neuro-MS/D** series and is intended for the acquisition of motor evoked potentials (see "Single Pulse Mode (MT)" chapter).

Before run the program you should check whether the devices (the magnetic stimulators of **Neuro-MS/D** series and **Neuro-EMG-MS** digital system) are connected to the same USB hub.

To provide the proper acquisition of motor evoked potential using **Neuro-EMG-MS** digital system, check whether the electrodes are connected correctly (the "belly–tendon" scheme is most often used). Electrodes should be connected to **Neuro-EMG-MS** digital system according to colors. Electrode color and socket color should match.

Before the surface electrodes placement degrease the skin in places of electrodes setting with the alcohol. The active electrode (black) is placed on muscle motor point, the reference one (red) is set on the tendon of this muscle or the bony prominence located distal the active electrode. The ground (green) electrode is placed higher the active and the reference ones.

**Example 1**. Ulnar nerve. The recording electrode is on abductor digiti minimi muscle (Fig. 79).
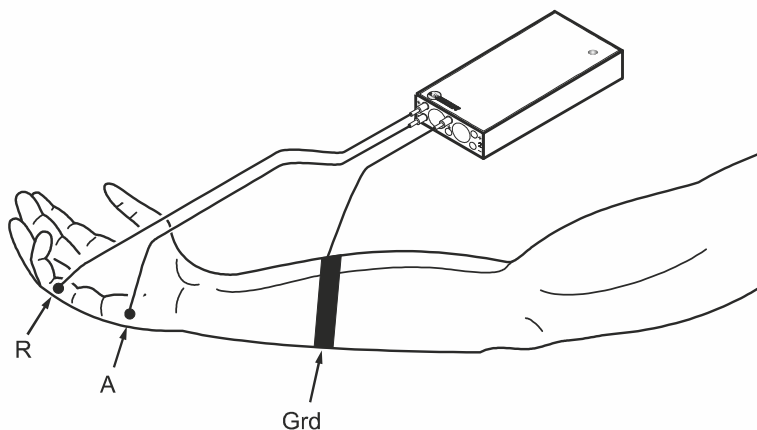


Fig. 79. MEP acquisition from abductor digiti minimi muscle.

To record the motor evoked potential from abductor digiti minimi muscle, it is required to degrease the skin in medial area of the hand surface. The reference (red) electrode should be placed on the point of abductor digiti minimi muscle fixation to abductor digiti minimi brevis muscle. It is indicated as a "R" point on Fig. 79. It is a little bit more distal the metacarpophalangeal articulation of a hand (over the base of proximal phalanx of little finger). The active electrode (black) should be placed on the middle of

head of abductor digiti minimi muscle, over the middle of the fifth metacarpal bone ("A" point on Fig. 79).

**Example 2**. Peroneal nerve. The recording electrode is on the extensor digitorum brevis muscle (Fig. 80).
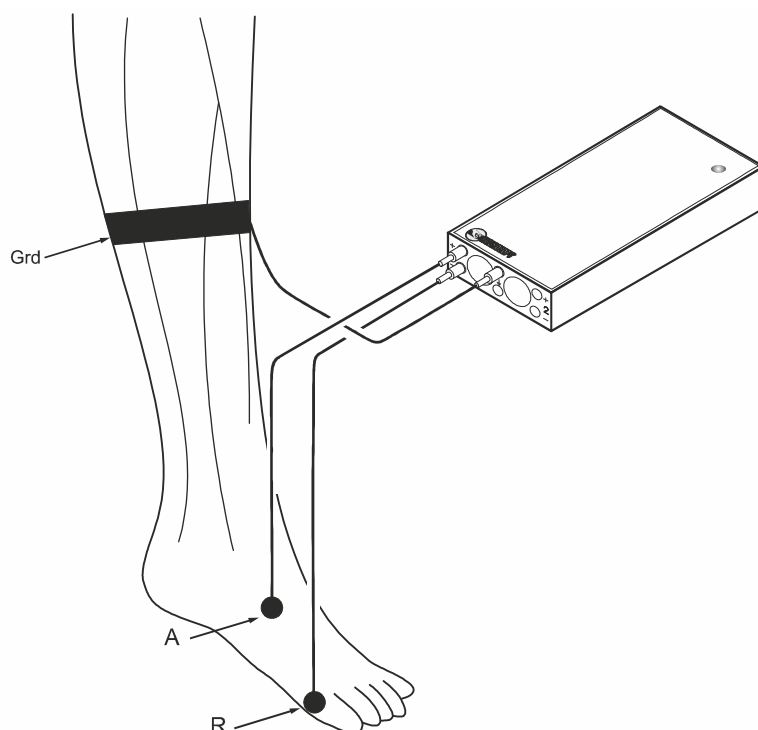


Fig. 80. MEP acquisition from the extensor digitorum brevis muscle.

To acquire the motor evoked potential from the extensor digitorum brevis muscle, it is required to degrease the skin from the lateral side of foot backside. The reference (red) electrode should be placed in the point of extensor digitorum brevis muscle fixation to the proximal phalanx of little toe. It is indicated as "R" point on Fig. 80. It is a little bit more distal the metatarsophalangeal articulation (over the base of proximal phalanx of little toe). The active electrode (black) should be placed on the middle of head of extensor digitorum brevis muscle, over the middle of the fifth metacarpal bone ("A" point on Fig. 80).

## 4.2.  Stimulation Parameters Ranges

Repetitive stimulation in **Neuro-MS.NET** is based on execution of separate stimulation subprograms. Each subprogram is represented as a set of perameters. Those parameters define the stimulation process.

The ranges of the admissible parameters during the different waveforms are represented in Table 2.

Table 2. The ranges of the admissible parameters at different waveforms

|  | Biphasic/monophasic* stimulation | Burst stimulation |
|---|---|---|
| Absolute amplitude, % | 1–100 ||
| Frequency in train, Hz | 0.1–30 | 0.1–25 |
| Frequency in burst, Hz | – | 1–100 |
| Pulses in train | 1–65535 | 1–500 |
| Pulses in burst | – | 2–10 |
| Pause between trains, s | 0–300 ||
| Trains count | 1–65535 ||

*Notes:*
*\* if you use the expansion unit.*

## 4.3. Footswitch Unit

The delivery set does not include the footswitch unit. The footswitch unit is connected to the computer by means of USB Interface. Pressing on the switch corresponds to execution of the menu command. In dialog mode pressing on the switch corresponds to pressing the keybord button (Table 3).

Table 3. Default footswitch commands.

| Pedal | Menu command | Buttons in dialogs |
|---|---|---|
| "Single pulse mode" page |||
| Left | **Stimulation\|Stimulus** | **Enter** |
| Middle | **Stimulation\|Intensity\|Increase** | **Tab** |
| Right | **Stimulation\|Intensity\|Decrease** | **Esc** |
| "Repetitive (session) mode" page |||
| Left | **Stimulation\|Start/Pause** | **Enter** |
| Middle | **Stimulation\|Pause** | **Tab** |
| Right | **Stimulation\|Stop** | **Esc** |

The footswitch can be custiomized (see "Hardware and Sorftware Configuration Settings" chapter, "Hardware" page).

# 4.4. Performing of Double-blind, Randomized, Placebo-controlled Trial

***Placebo-controlled trial*** is a comparative study in which the effectiveness of full course of magnetic therapy is compared with placebo, where amplitude of repetitive stimulation is reduced by several times.

***Randomized trial*** is a trial in which patiens are randomly assigned to any of the groups (special randomization procedure is used) and have equal chances to take a full course of magnetic therapy or therapy with reduced amplitude of repetitive stimulation (placebo).

***Double blind trial*** is a trial in which patient and doctor have no information about group (experimental or control) to which the patient belongs to.

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**Neuro-MS.NET** software provides the opportunity to perform double-blind, randomized, placebo-controlled trial **using magnetic stimulator with not lower than 25 firmware version and standard (not placebo) coil***.*

**Scheme:** Researcher ⇨ Doctor ⇨ Patient

**A researcher has sole rights to setup parameters, start and end placebo trials, and get trial results. In this scheme doctor and patient should follow software instructions only.**

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To open the window of placebo trial setup use **Setup|Edit** menu command, the "Software" tab, the "Placebo-controlled trial" group box. The window of placebo trial setup is represented in Fig. 81.

Use buttons located at the top part of the window to perform the following actions:

- ➕ — add treatment course template the effectiveness of which is to be studied (see chapter 3.4 "Course Templates");

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**The course template added becomes unchangeable.**

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- ➖ — delete treatment course template;

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**If you delete the course template you lose data for this placebo trial.**

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- 🔧 — setup placebo trial report template (the same as treatment report template setup) (see chapter 2.17 "Treatment Report Templates").

> **To add placebo trial data to report template, use the "Placebo" element.**
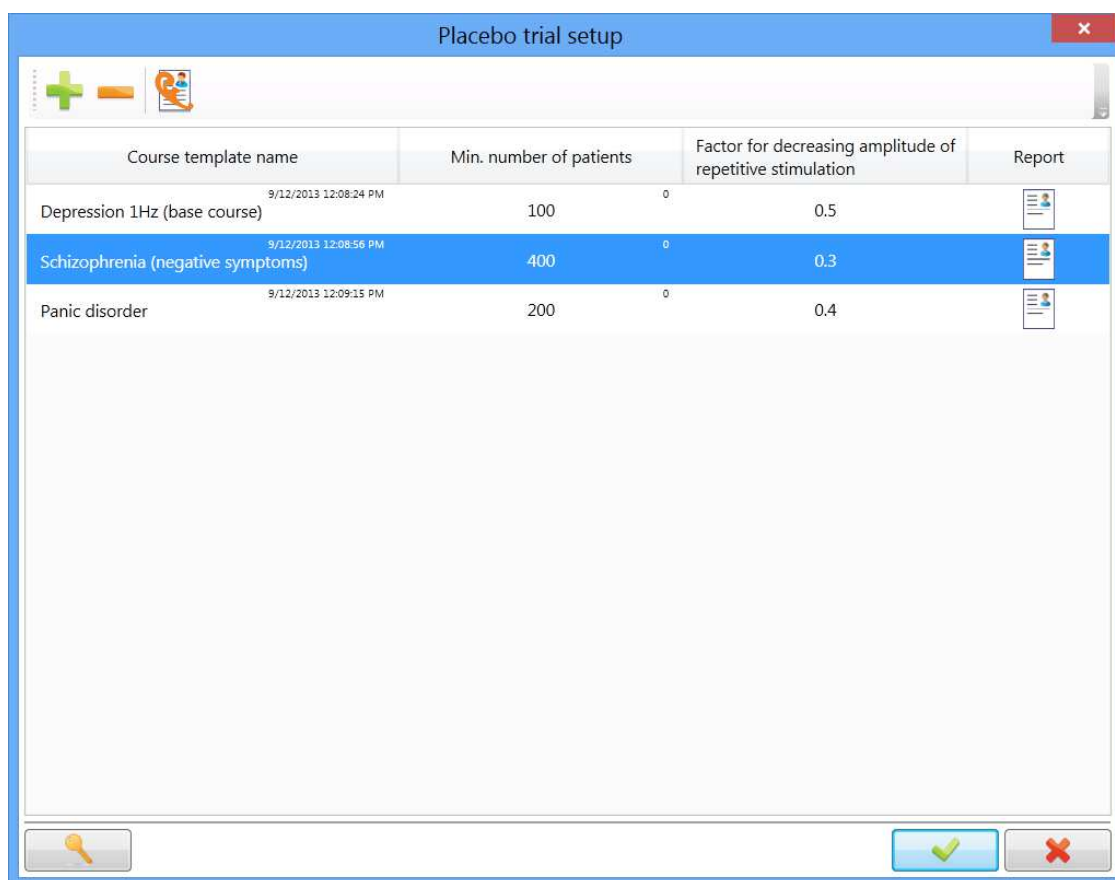


Fig. 81. Placebo trial setup window.

Table list of placebo-controlled courses contains the following data:

- "Course template name" — the name of course template, the effectifeness of which is studied. Time and date of placebo trial beginning are displayed in the top right corner of the window.

- "Min. number of patients" — the minimal number of patients for trial (10 ... 65535). This parameter is used for the random distribution of patients between groups. The number of patient took part in placebo trial by this course template is displayed in the top right corner of the window.

- "Factor for decreasing amplitude of repetitive stimulation" — the factor for imitative decreasing of repetitive stimulation amplitude for the imitation of placebo treatment (0.1 ... 1).

- "Report" — the possibility to generate a report by each course template included into a placebo trial. Click on the ⊟.

> **The "Min. number of patients" and the " Factor for decreasing amplitude of repetitive stimulation" becomes unavailable for changing if at least one patient have already took part in placebo trial by corresponding course template.**

If you want to have an exclusive access to the window of placebo trial setup, you can protect it with password using the [🔑] button.

To save changes click on the [✓] button, to chancel — the [✗] button.

Work with Neuro-MS.NET software within the frameworks of placebo trial has some slight differences. If the patient is ordered to take a course of treatment from the list of course templates, and this template is included into the protocol of placebo trial, the program makes the treatment algorithm unavailable for changing. Before the repetitive stimulation start the program will ask you to use earplugs for patient and doctor to protect placebo trial privacy. In other aspects the work of Neuro-MS.NET software does not differ.

# 4.5. If You Have No Dedicated Keyboard

To facilitate the initiation of stimulation program and work with traces **Neuro-MS.NET** offer to use an extra dedicated keyboard. This keyboard can be placed near the patient to provide the opportunity to perform necessary actions quickly and correctly.

If you use the amplifier unit which has no built-in keyboard (**Neuro-MEP, Neuron-Spectrum, Neuro-EMG** etc.), it is strongly adviced to use wireless Bluetooth keyboard manufactured by **Neurosoft** Ltd.

# References

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