Somatosensory entrainment of suck in preterm infants: NTrainer

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1 NTrainer *RT* Setup

NTrainer *RT*© (*real time*) was created for simulation of suck pressure of non-nutritive suck (NNS), which in turn is used to train the sucking ability of premature babies with no functional suck or at-risk for developmental disabilities. A biphasic square wave pulse pattern, with a pulse frequency similar to NNS, is written onto channel DAC0 of the NI 6052E PCI DAQ board. At the same time, up to three analog channels are sampled, including the output of the DAC, intraluminal nipple pressure, and jaw kinematics or other desired channel (i.e., oxygen saturation pressure).

1.1 Hardware

The Hardware for NTrainer includes:

→ A PC with Windows XP and 1 GB RAM

→ NI DAQ 6052E PCI multifunction I/O card

→ Position Servo controller (BioCom Electronics, LLC)

→ Bridge amplifier (s): 2-channels

→ Pneumatic pressure cylinder actuator

→ Linear Motor

→ Pressure transducer

The hardware listed above is shown in Figure 1. Most of the hardware (linear motor, pneumatic pressure actuator, power amplifier, pressure transducer, etc.) is concealed in a shielded cabinet within a wheeled cart which is position cribside in the NICU. A detailed view of the linear motor-actuator and air cylinder with pressure lines, pressure transducer and Luer fittings is given in Figure 2.

Figure 1. NTrainer RT hardware set up

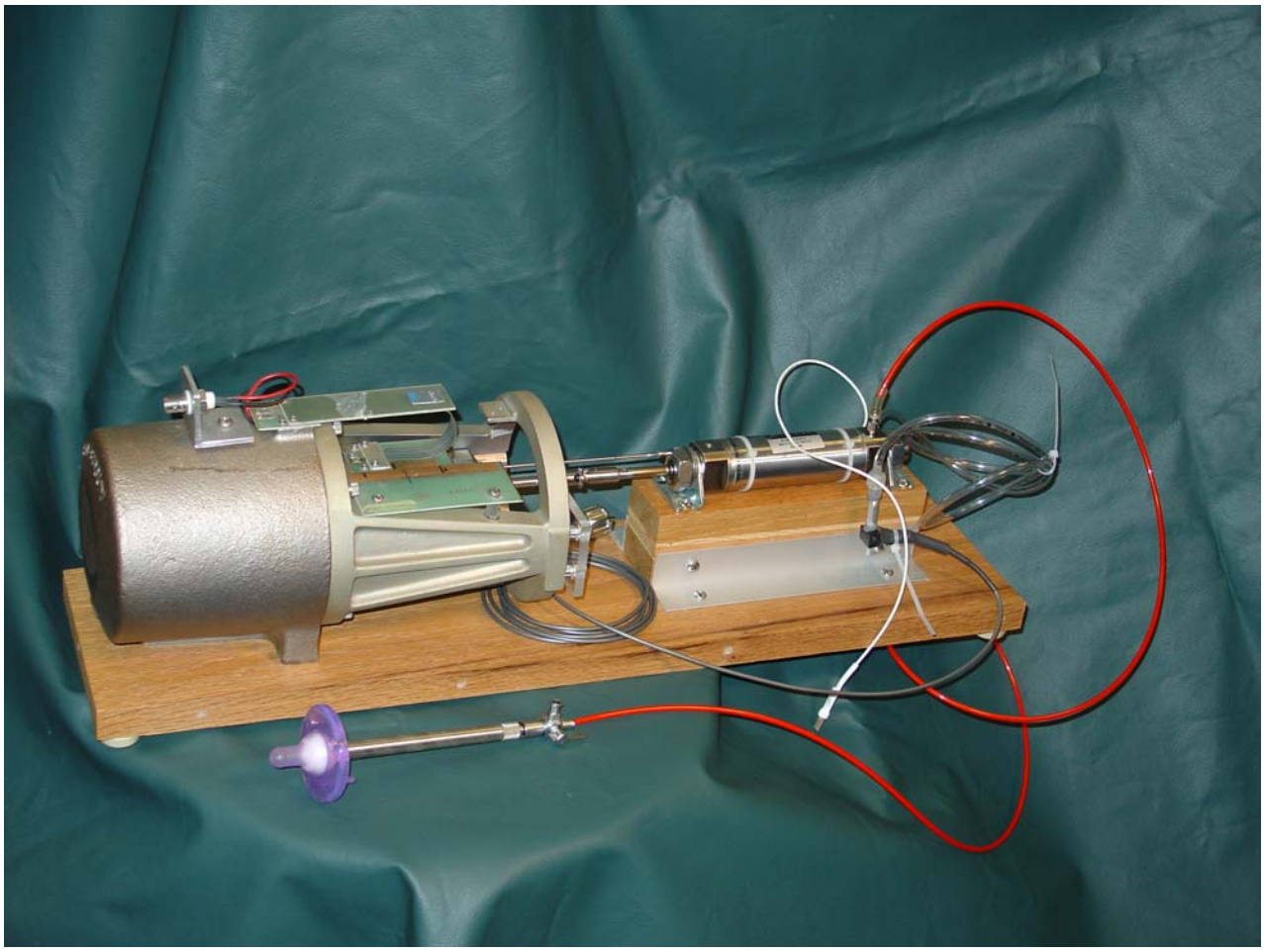


Figure 2. Linear Motor-pneumatic actuator assembly

1.2 Software

NTrainer *RT* is coded by C# (5,448 coding lines). This software performs the function of controlling the start and stop of the synthesized patterned orofacial somatosensory stimulation, generating the impulse with NNS pattern, and updating an integrated database of patient parameters, including patient ID, birth age, age at test, and a cumulative history of stimulation parameters (stimulus train characteristics: amplitude, frequency, pulse width, pulse rate, pulse length, train rate, and number of pulses generated per session).

1.3 Program Installation:

Uninstall any previous installed versions of **NTrainer *RT*** using **Control Panel > Add/Remove Programs**. Install **NTrainer *RT*** by running *setup.exe* from the installation package.

Note: Normally, it works with BNC-2090(Figure 3). To work with BNC-2110 (Figure 4) BNC terminal box please make the following change:

Figure 3. BNC-2090

Figure 4. BNC-2010

For BNC-2110

To work with BNC-2110, terminal configuration has to be in differential mode. The Terminal configuration can be set to *differential mode* by modifying the parameter value of

"defaultAiTerminalConfig" to "1" under <systemConstants> section in the file **NTrainer.exe.config** located in C:\Program Files\Neuro Logic\NTrainer RT\. Here is the line from NTrainer.exe.config that shows this parameter value

<add key="defaultAiTerminalConfig" value="1" />

"defaultAiTerminalConfig" can have the following values:

value="1" for **Differential**

value="2" for **Referenced single ended**

value="3" for **Nonreferenced single ended**

By default, the file NTrainer.exe.config contains value = "3" for "defaultAiTerminalConfig". This setting is used to work with BNC-2090. Here is the line from NTrainer.exe.config that shows this parameter value

<add key="defaultAiTerminalConfig" value="3" />

2 User Manual

To run **NTrainer *RT***, double click on the program icon. The main program should appear with a menu bar along the top, three blank waveform panels along the upper half of page, patient's information on the bottom left side, and patient's visit information displayed along the bottom right margin. As shown below (Figure 5) the menu bar has four active options including **Patient, Settings, Tools,** and **Help.**

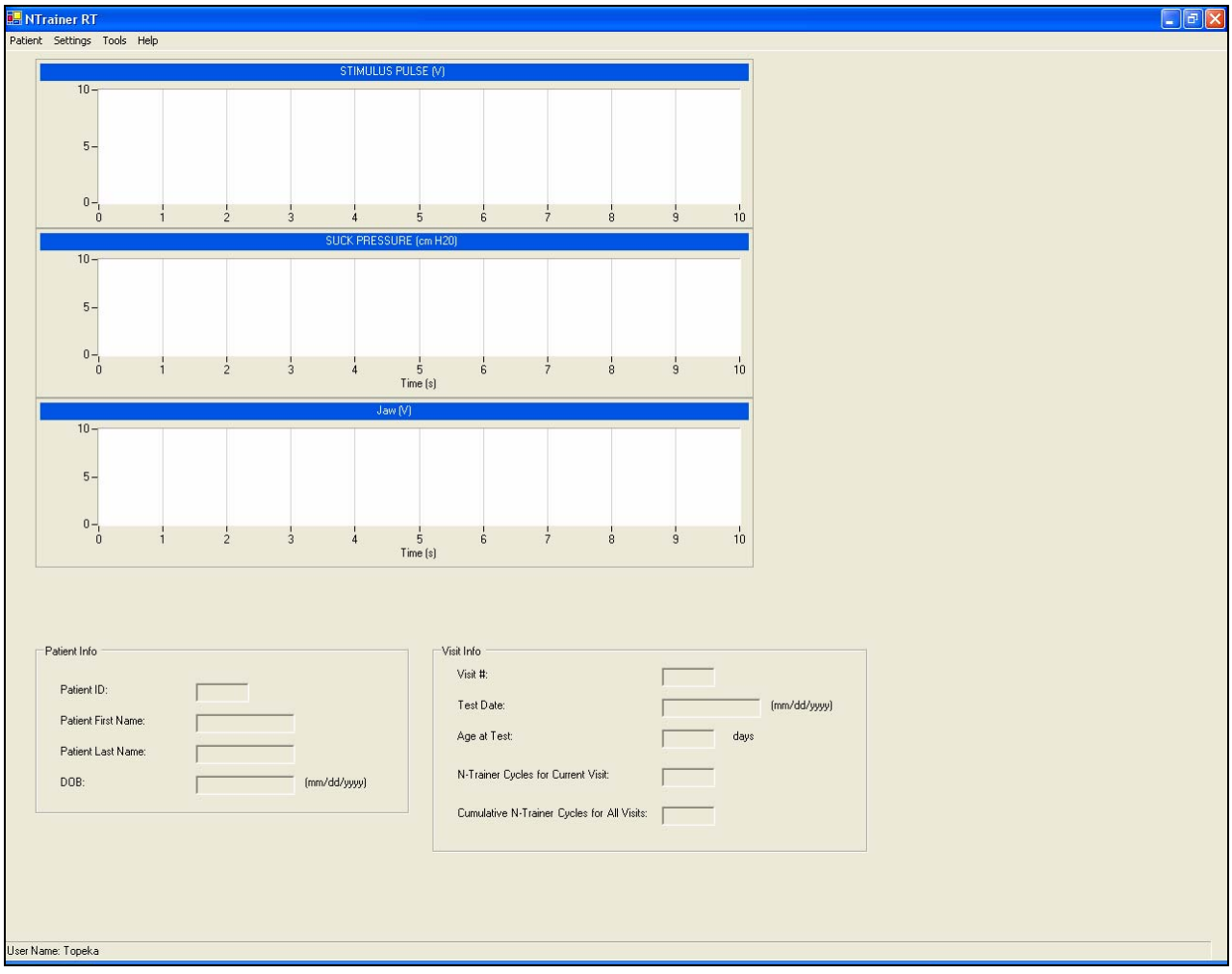


Figure 5. Main program window of the NTrainer *RT* user interface

The bottom of the program window appears with the Patient's information and Visit information. The Patient's information panel includes the **Patient's ID**, **First Name**, **Last Name** and Date of Birth (**DOB**). The Visit Information panel includes the total number of Ntrainer

Visits, **Test Date**, **Age at Test**, **NTrainer Cycles for Current Visit**, and **Cumulative NTrainer Cycles for All Visits**.

2.1 Overview of menu bar options

As shown in Figure 6, selecting **Patient** allows the user to choose a **New** file name for the recording session.

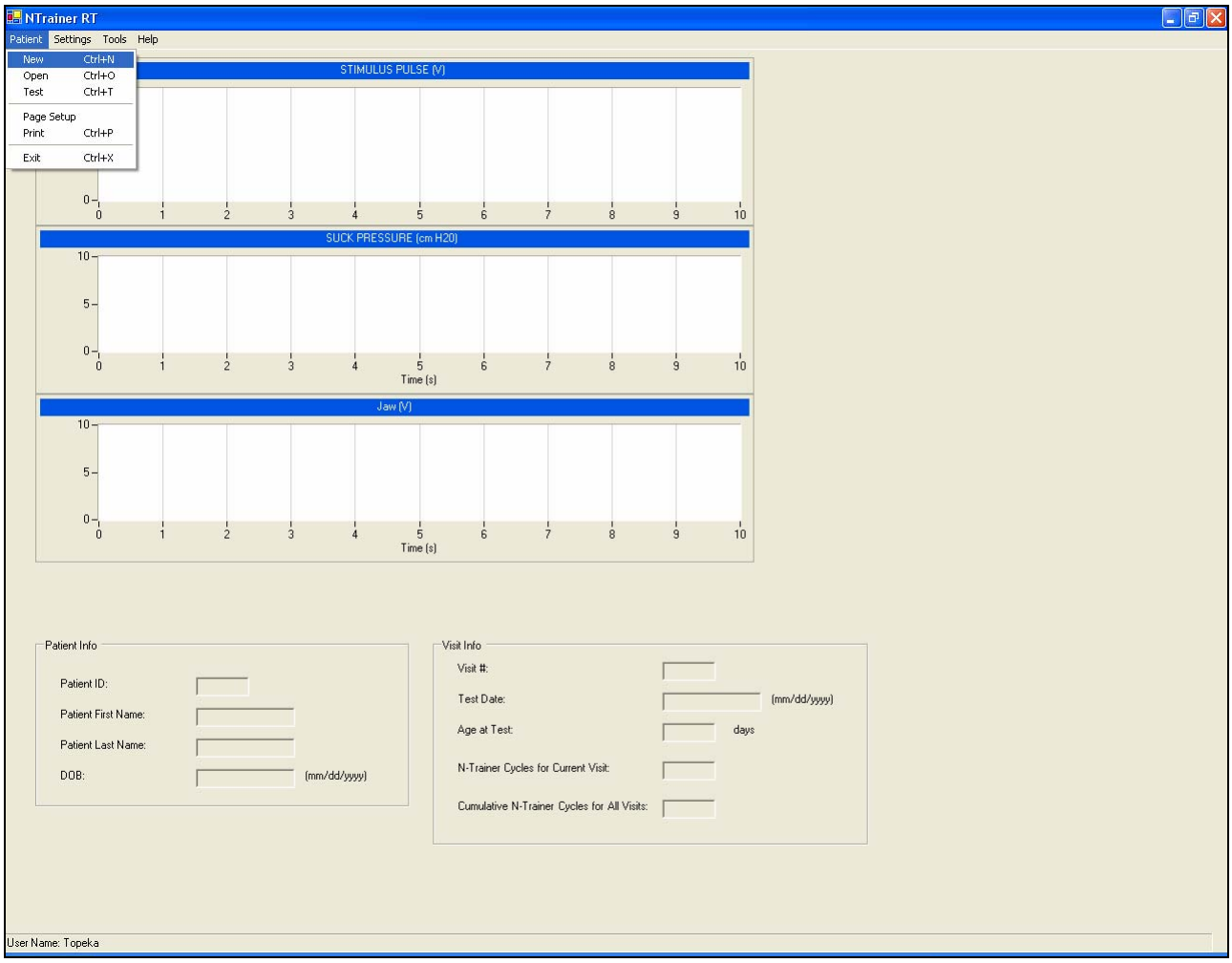


Figure 6. Main program window with the Patient Info menu option list displayed

This menu is divided into three function blocks. The first block contains three options: The first option for creating a new data filename, the second option for opening an existing file for data analysis, and the third option for opening an existing file for **NTrainer *RT*** stimulation. The second block contains page setup and printing options. The final block contains the **Exit** command.

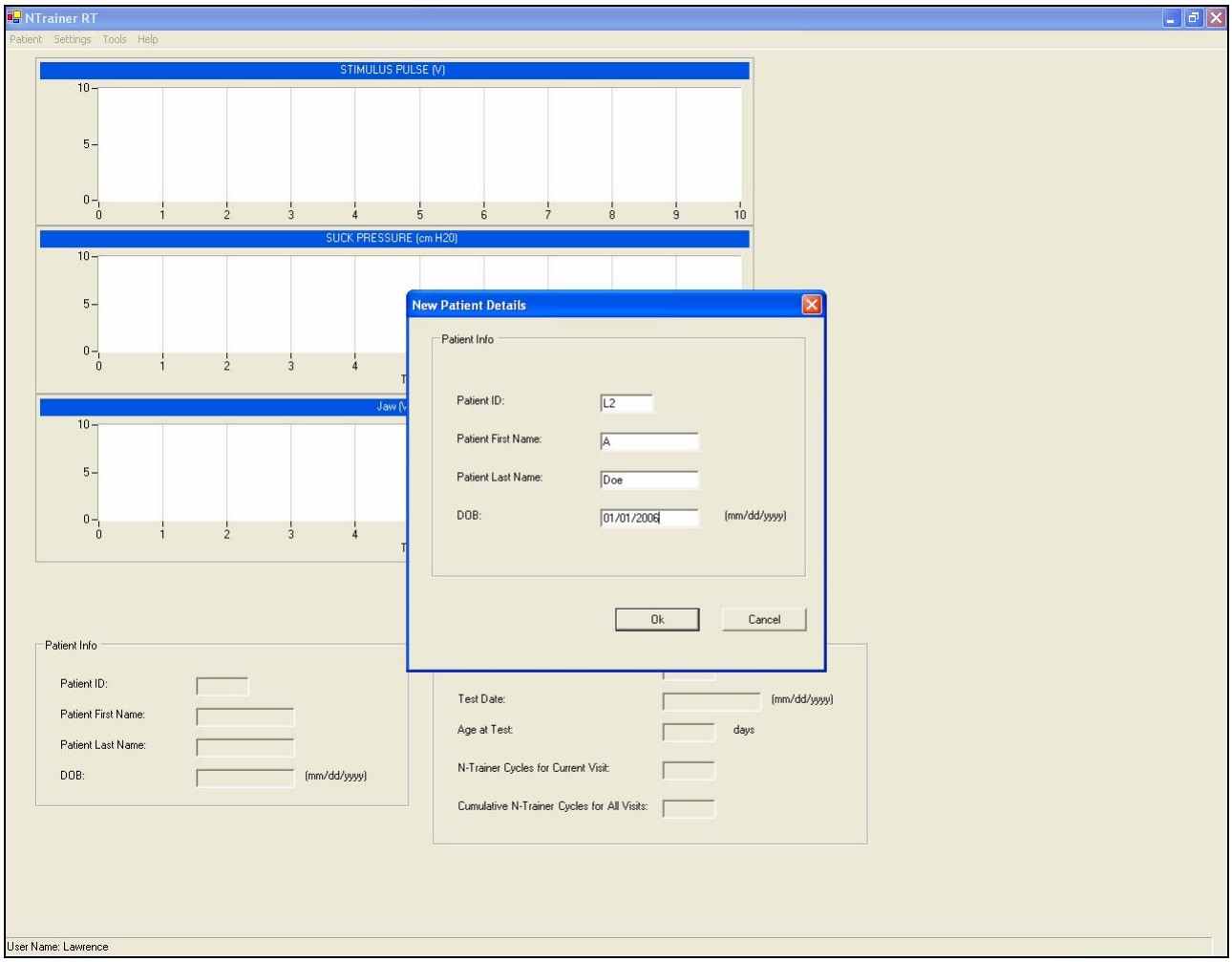


Figure 7. Main program window of creating a new patient database

Selection of **New** option will allow the user to insert the patient's information such as **Patient ID**, **Patient First Name**, **Patient Last Name**, and **DOB** (see Figure 7).

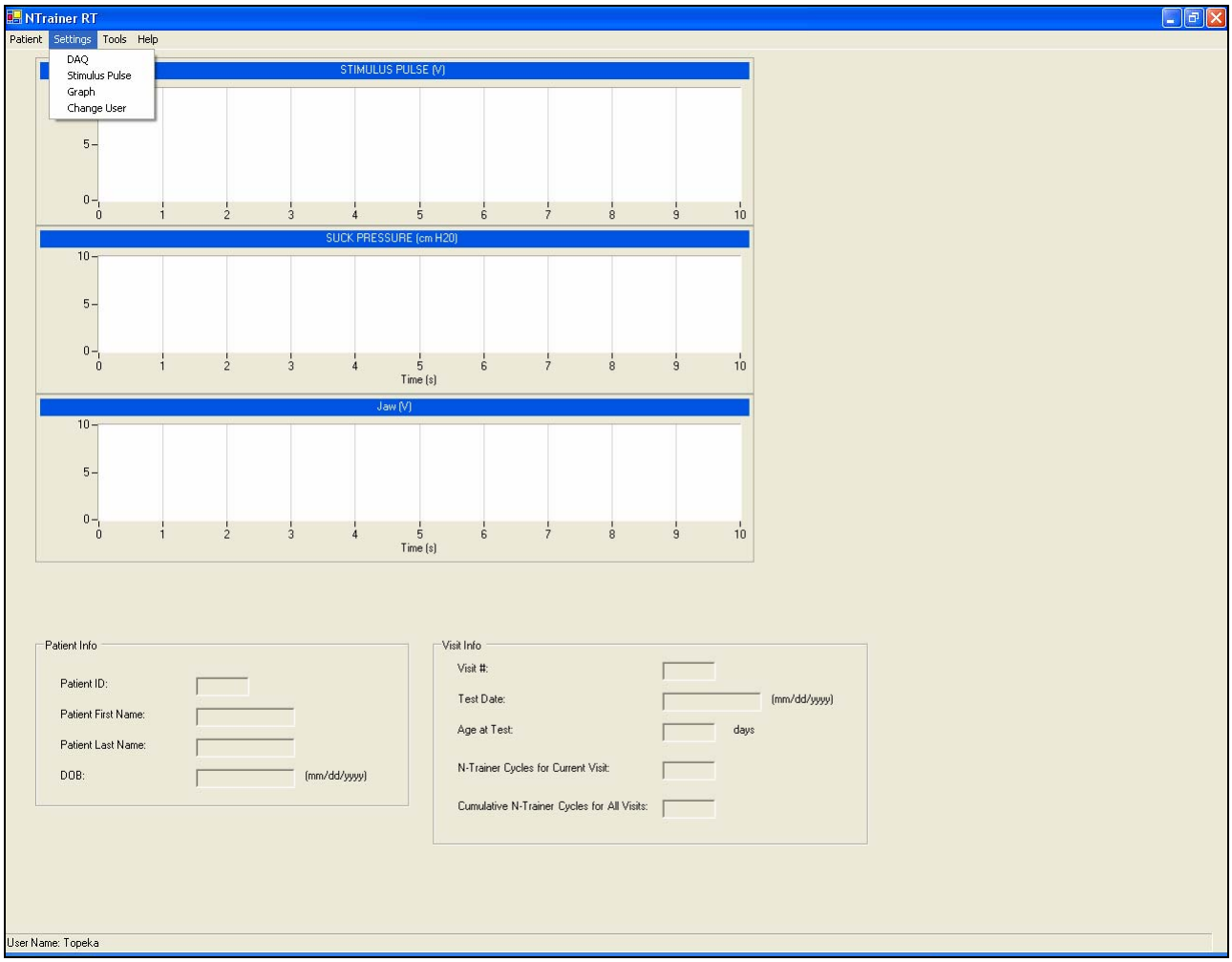


Figure 8. Main program window with the Settings menu option list displayed

The Settings menu (Figure 8) provides user access to **DAQ**, **Stimulus Pulse**, **Graph**, and **Change User**. User may adjust the parameters within each submenu's dialog box.

The **DAQ** submenu allows the user to select the **Device Type** and map analog-to-digital channel (ADC) assignments for **Stimulus Pulse**, **Suck Pressure,** and **Jaw** as shown in Figure 9**.**

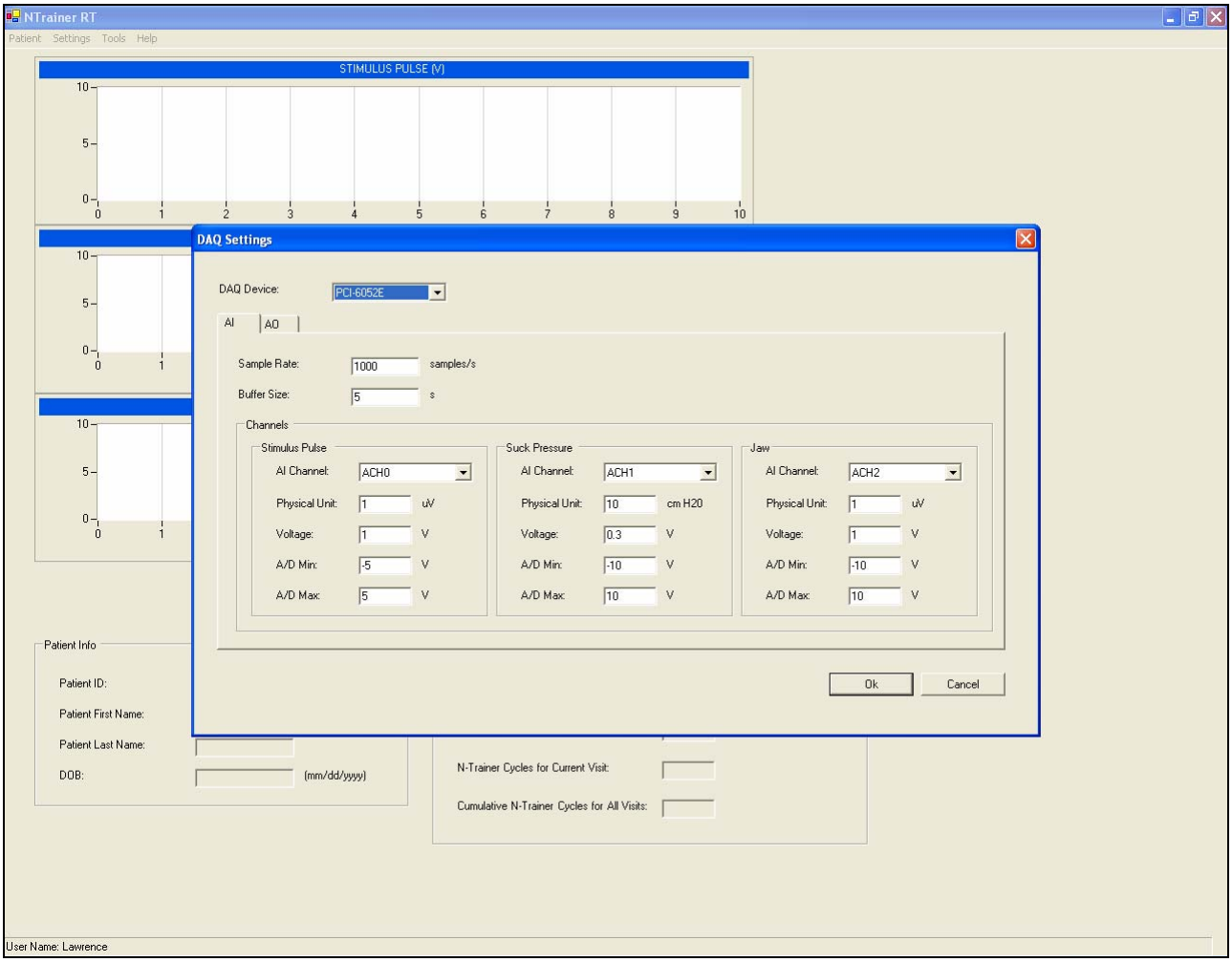


Figure 9. Main program window with the DAQ Settings submenu option list displayed

The **Stimulus Pulse** submenu contains scaling options for **Pulse Rate** (Hz), **Pulse Train** length (number of pulses), **Pulse Amplitude** (Volts), **Pause Period** (seconds), and **Train Rate** (Hz) as shown below (Figure 10).

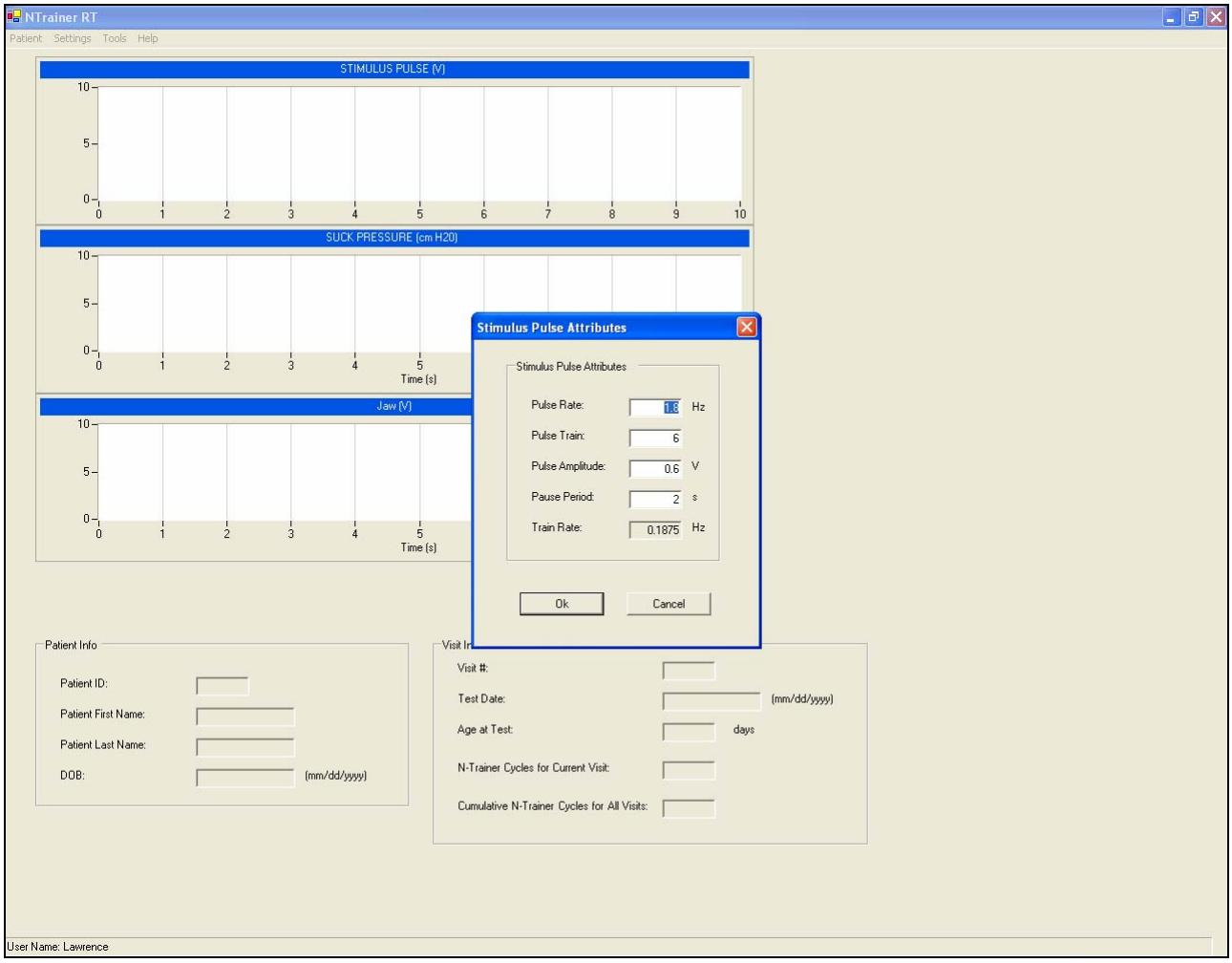


Figure 10. Main window program of Stimulus Pulse Attributes

The **Graph Settings** submenu provides user access to Y-axis and X-axis display settings for **Stimulus Pulse**, **Intraluminal Suck Pressure,** and **Jaw** as shown in Figure 11**.**

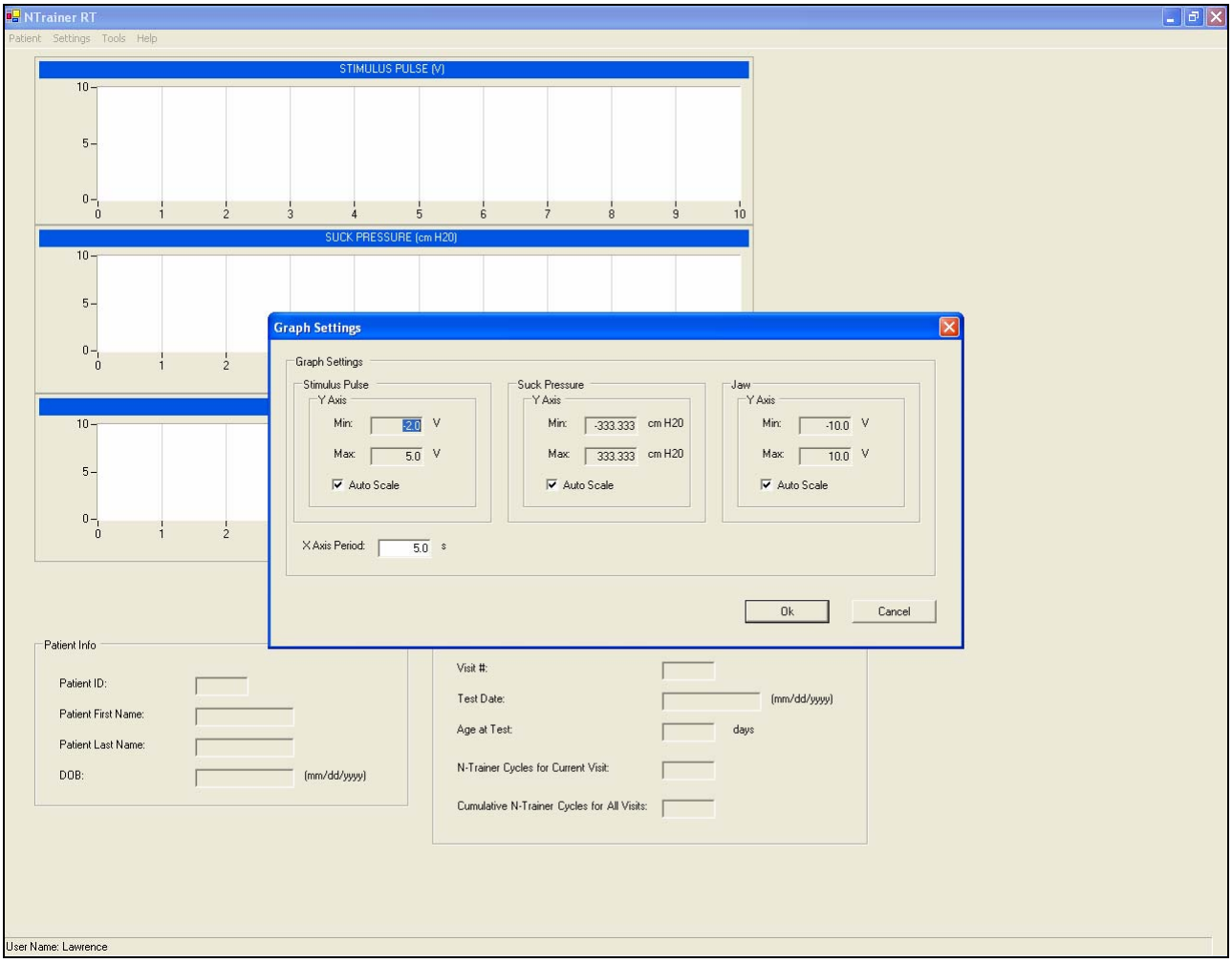


Figure 11. Main program window with the Graph Settings menu option list displayed

The **Change User** submenu allows the user to choose the data collection sites (i.e., NICU hospital test locations) as shown in Figure 12.

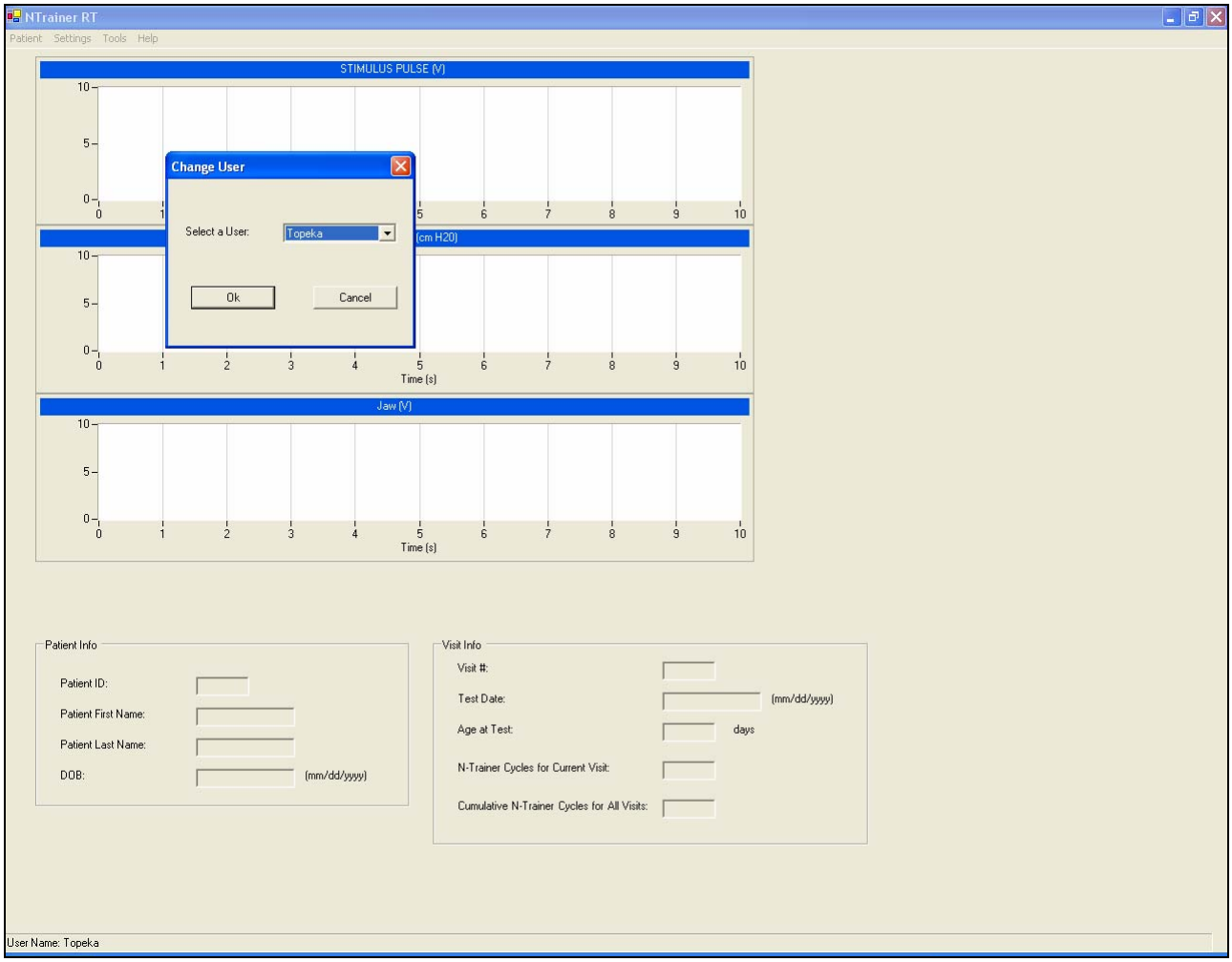
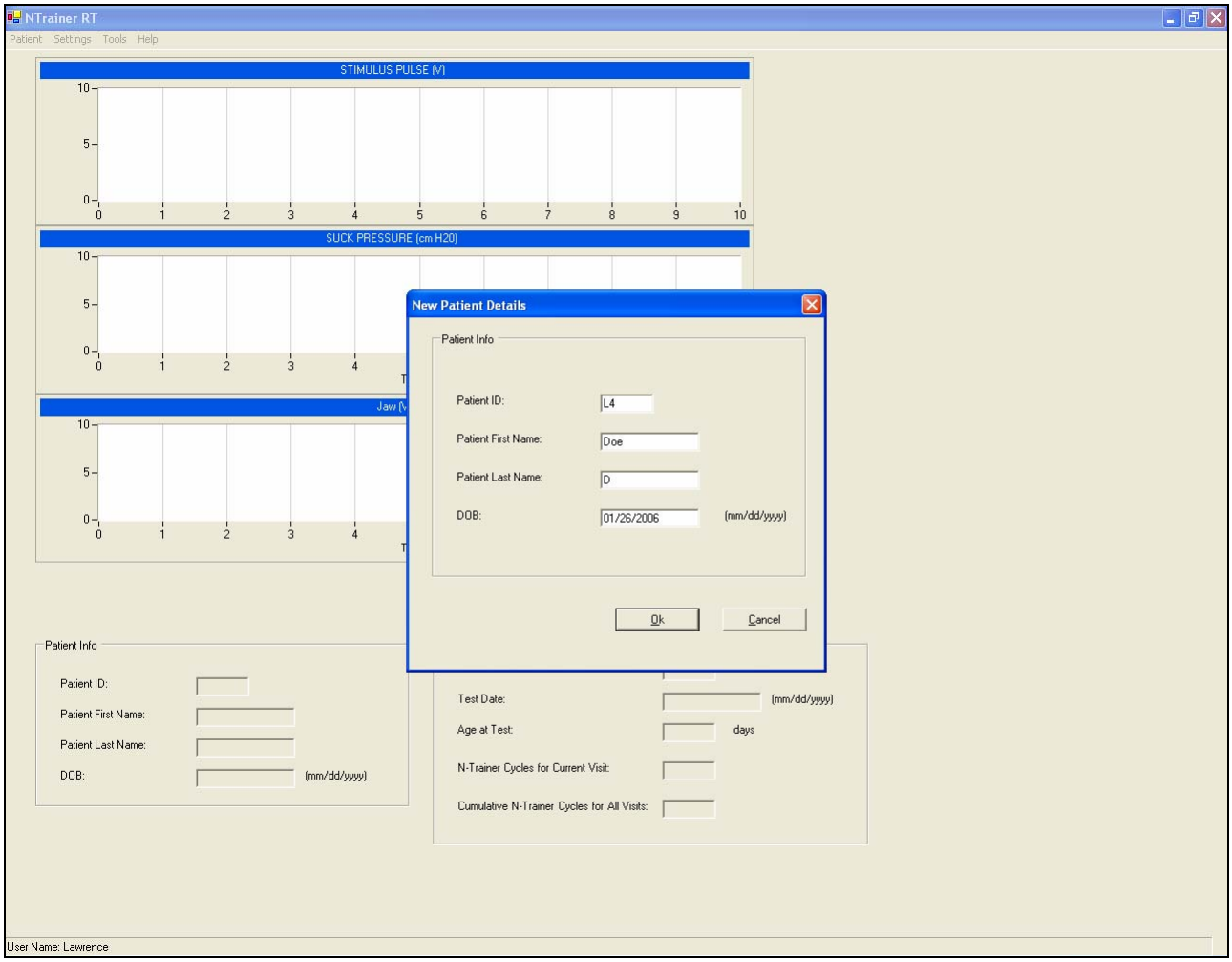


Figure 12. Main program window of users

2.2 Record new data using NTrainer *RT*

2.2.1 How to create a new file

Select **Patient → New,** and fill in the response field for data file name and click **OK**. A window message will appear on the main window screen to inform the user that the patient's information has been added into the database as shown below (Figure 13).



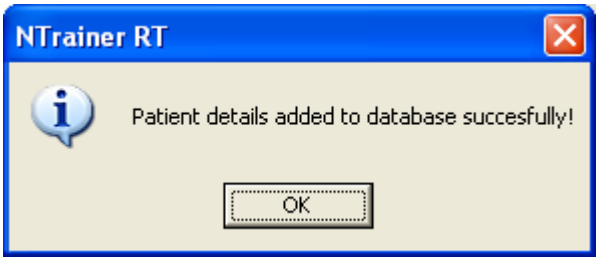


Figure 13. Main program window of New Patient Details

2.2.2 How to provide NTrainer *RT* neurotherapeutic oral stimulation

After entering patient's information into the **NTrainer *RT*** database (refer 2.2.1), the user can provide neurotherapeutic oral stimulation by selecting **Patient →Test**. A **Patient List** window will appear on the main program window for the user to select the patient. Highlight the patient's name you wish to test and click **OK.**

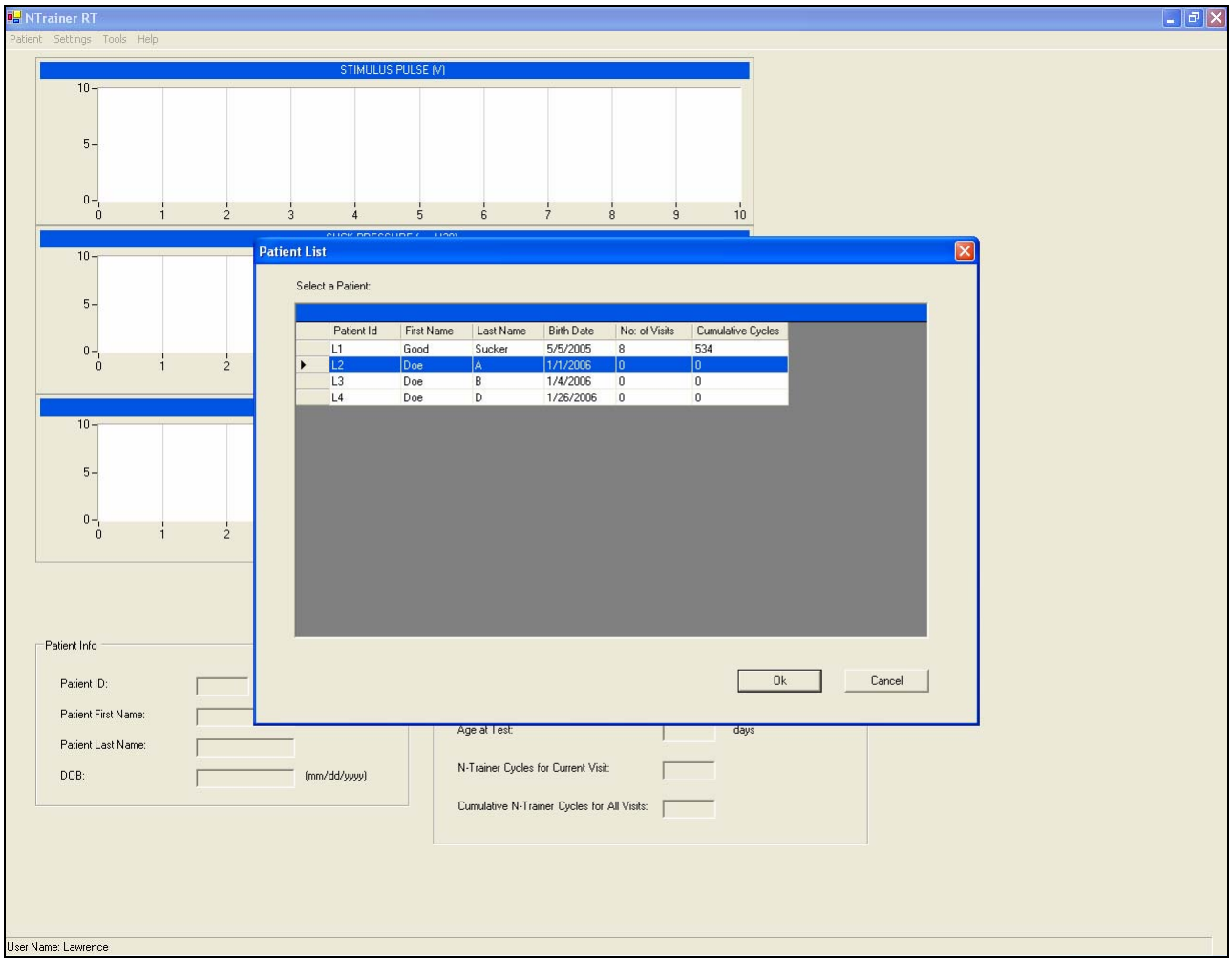


Figure 14. Main program window with the Patient List submenu option list displayed

The user may **Stop** and **Resume** the patterned orosensory stimulus delivery by simply clicking on the window shown in Figure 15. The pacifier receiver of the NTrainer unit is instrumented with a wireless mouse (Figure 16) which allows the user to remotely **Start**, **Stop**, and **Resume** stimulus delivery while attending to the infant. In this way, the user does not need to interrupt direct intervention or handling of the infant since program control can easily be directed from the wireless mouse.

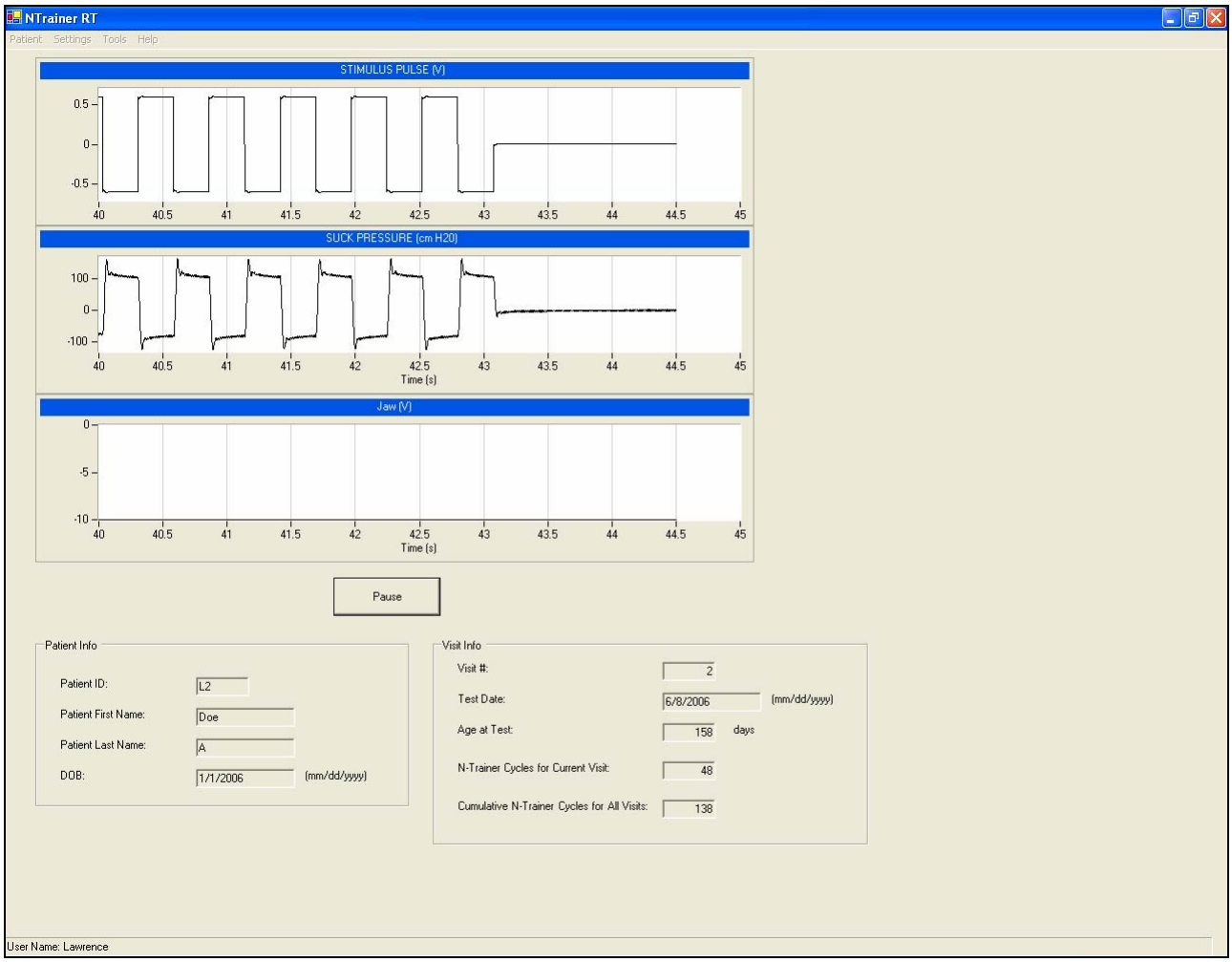


Figure 15. Example of an NTrainer *RT* main program

Figure 16. Remote control for NTrainer RT – Wireless Mouse, and regular mouse. User could control NTrainer by both of them

2.3 Review an NTrainer data file using NTrainer RT

Select **Patient → Open.** A **Patient List** will appear and the user can select the patient's file to review (Figure 17).

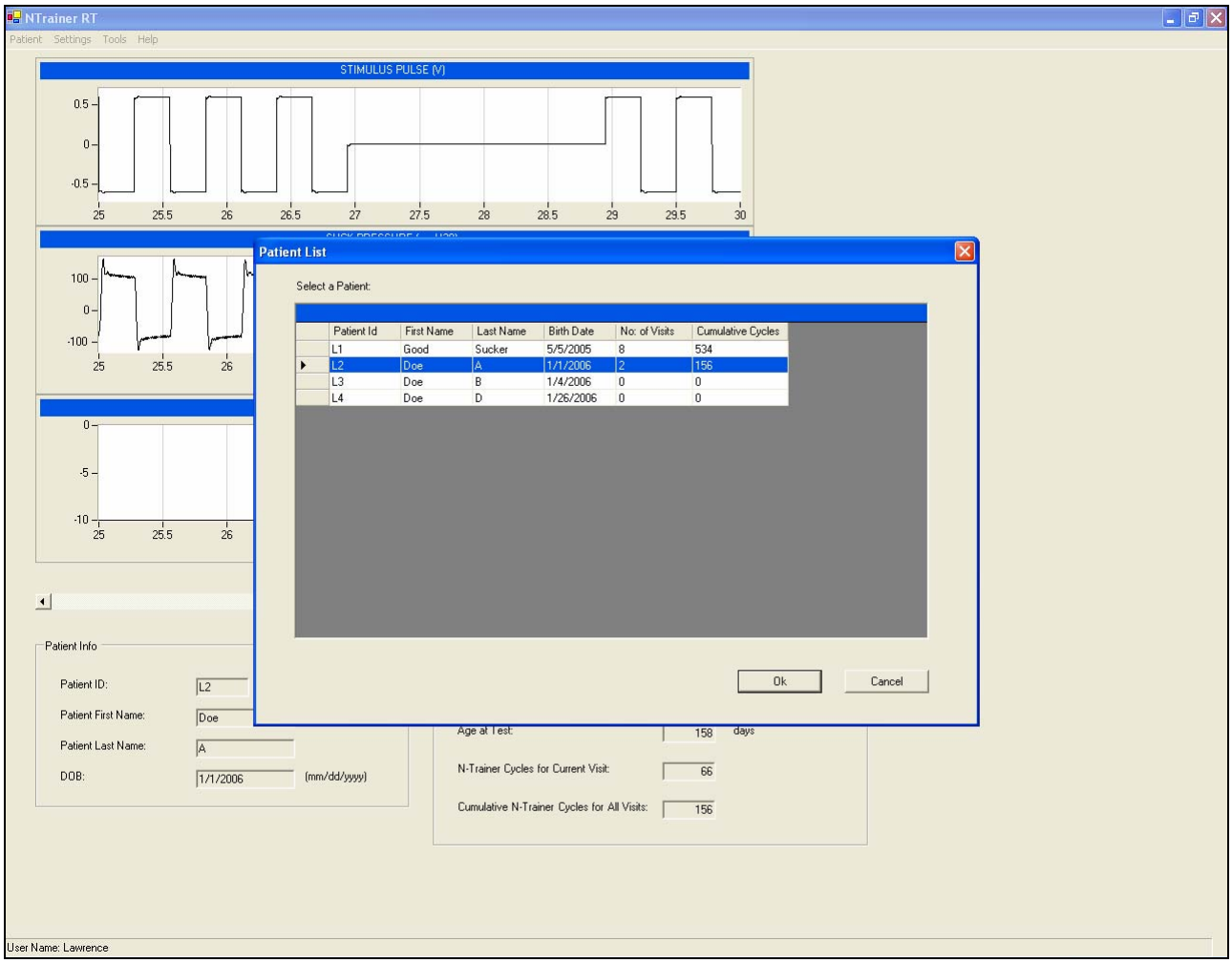


Figure 17. Main window program of Patient List

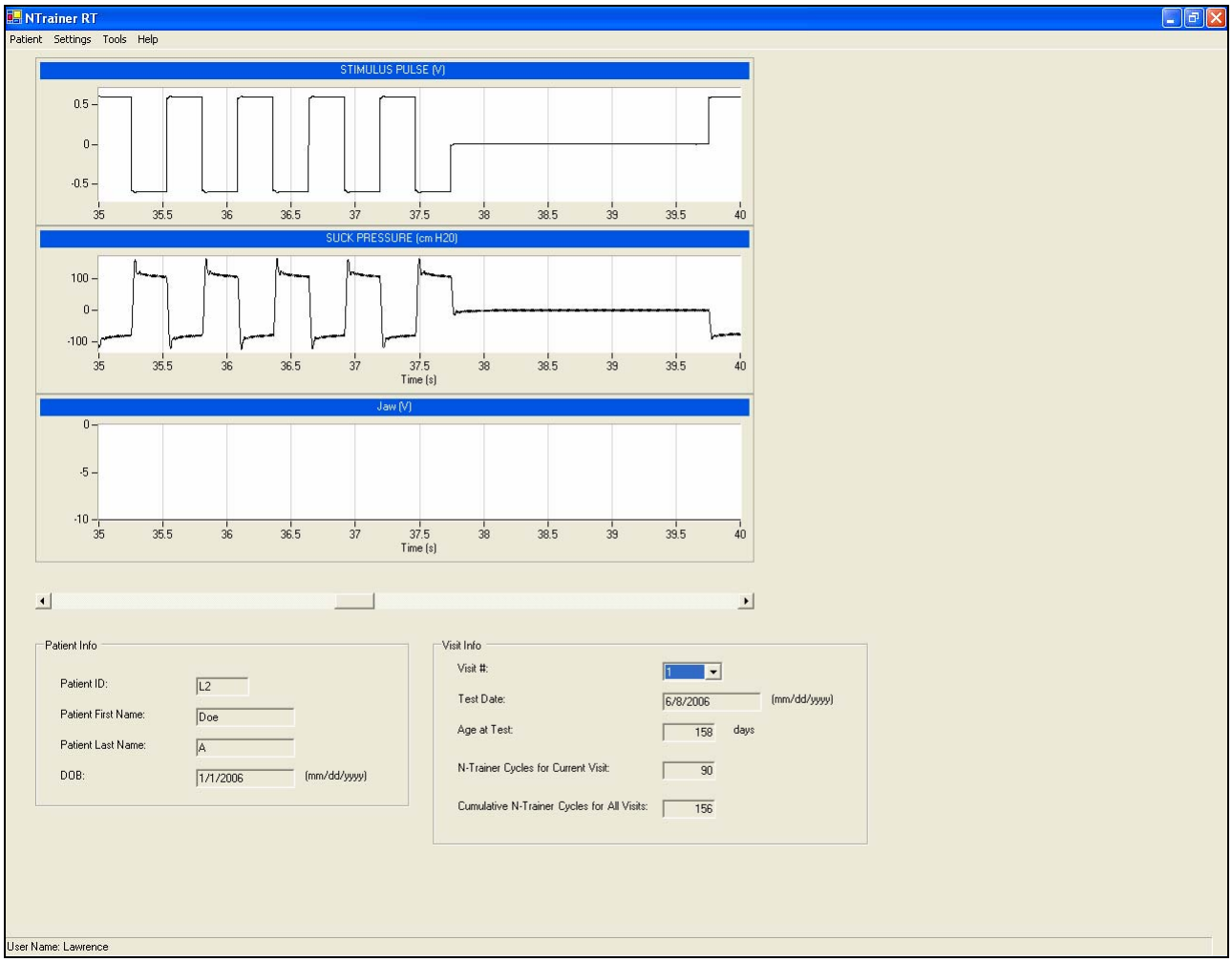


Figure 18. Main window of a patient's NTrainer data file

After a patient file is selected, all of the patient's personal parameters and the corresponding NTrainer data file will be shown as exemplified in Figure 18. Note that the user can select a previously completed NTrainer session file by simply choosing it at the **Visit #** icon.

3 References

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