ASL 5000
Breathing Simulator

Addendum for RespiSim Software Option

Software Version 3.5.0

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What Is Covered

This addendum to the Operating Instructions of the ASL 5000 High Fidelity Breathing Simulator covers setup and use of the RespiSim interface software as well as the optional RespiSim Ventilator Interface Kit (VIK).

Intended Use of the RespiSim Option

RespiSim is intended to create a fully integrated respiratory simulation experience for training in the subjects of mechanical ventilation and ventilator management.

RespiSim is built on immersive simulation and dynamic clinical reality. With the high fidelity ASL 5000 Breathing Simulator as the lungs of the simulated patient, it represents a completely new method of teaching the subject of managing the delicate interactions between a patient and the ventilator in a truly interactive fashion. RespiSim gives the instructor the ability to:

— have full control of all aspects of a simulation,
— capture data from the ASL 5000 Breathing Simulator, the connected ventilator (optional), and the vital signs monitor,
— provide learners with the patient status using the vital signs monitor,
— mark and annotate events, and
— replay the compiled recording during debriefing sessions or for classroom instruction.

Developed in collaboration with leading educators, preconfigured RespiSim curriculum modules save instructor time by providing a comprehensive, multi-media package of materials that describes and demonstrates a concept or scenario within the subject of mechanical ventilation.

Precautions

WARNING !

- NOT FOR USE ON A PATIENT -

The ventilator data acquisition and storage system of RespiSim is not intended to monitor, chart, or store data coming from actual patients or for the purpose of assisting in clinical decisions regarding actual patients[1]

1. *Please contact Bridgetech Medical at bridgetechmedical.com for information about their system for electronic record keeping of respiratory data in stationary care.

1 RespiSim Windows

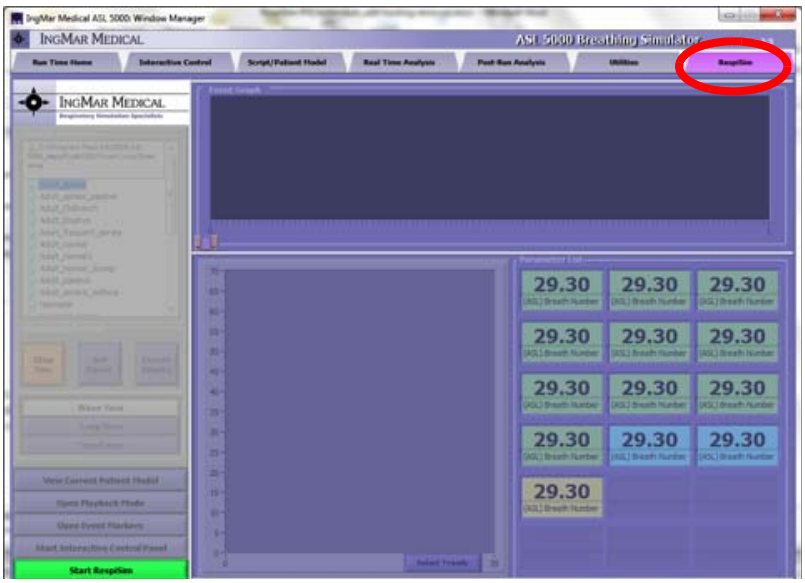

Figure 1-0 RespiSim Tab on the Window Manager

The RespiSim tab is the furthest to the right on the ASL 5000 Windows Manager. Pressing the Start RespiSim button loads RespiSim.

1.1 Instructor Dashboard Guide

the ability to implement ventilator (reference) settings, vital signs, and ABG values that, together, represent a patient's current status.

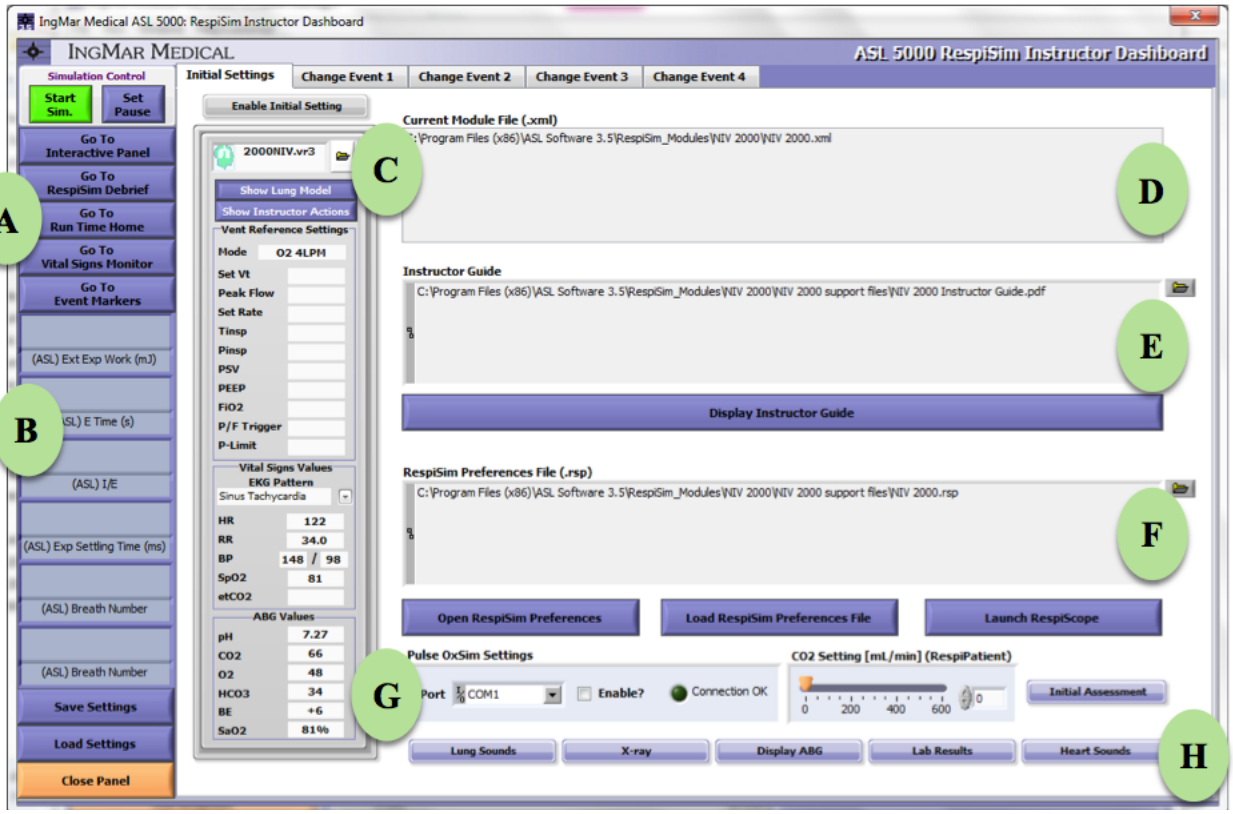

Figure 1-1 Instructor Dashboard

The ***Instructor Dashboard*** greatly simplifies simulation management and gives the instructor full control of all aspects of a simulation.

A: **Control and Navigation Buttons** - Start / stop and invoke a pause patient model as well as navigate to other tabs and windows within the ASL 5000 Software, including ***Interactive Control Panel*** (ICP), ***RespiSim Debrief*** panel, ***Run Time Home, Vital Signs Monitor*** (VSM), and ***EventMarkers.***

B: **Display Parameters** - The most significant parameters from the ASL 5000, the connected ventilator (optional), or the simulated ***Vital Signs Monitor*** (VSM) can be displayed in these six fields. All fields can be changed anytime by clicking on the parameter name.

C: **Lung model and Vent Settings** - Create patient models using the simulation script editor and upload .vr3 files into the instructor dashboard to show learners the progression of a patient's disease state. The instructor has

D: **Current Module File (.xml)** - This is the file that is called from the Load button at the bottom left of the Dashboard window.

E: **Instructor Guide** - Provides step-by-step instructions on running the simulation to meet learning objectives (in PDF format).

F: **Preferences File (.rsp)** - Many aspects of the visual appearance of the RespiSim interface may be predefined via sets of preferences. These preferences allow the instructor to customize the instructional environment to the specific subject being taught. For example, only those parameters most relevant to the subject should be made visible, thus avoiding unnecessary clutter and informational overload.

G: **External Device Controllers** - These controls are for the external SpO2 pulse oximeter and the CO2 infusion for users of the RespiPatient® option.

H: Instructor-Driven Patient Vitals - include ABGs, chest X-rays, lab results, as well as heart and lung sounds.

1.2 RespiSim Debrief Window

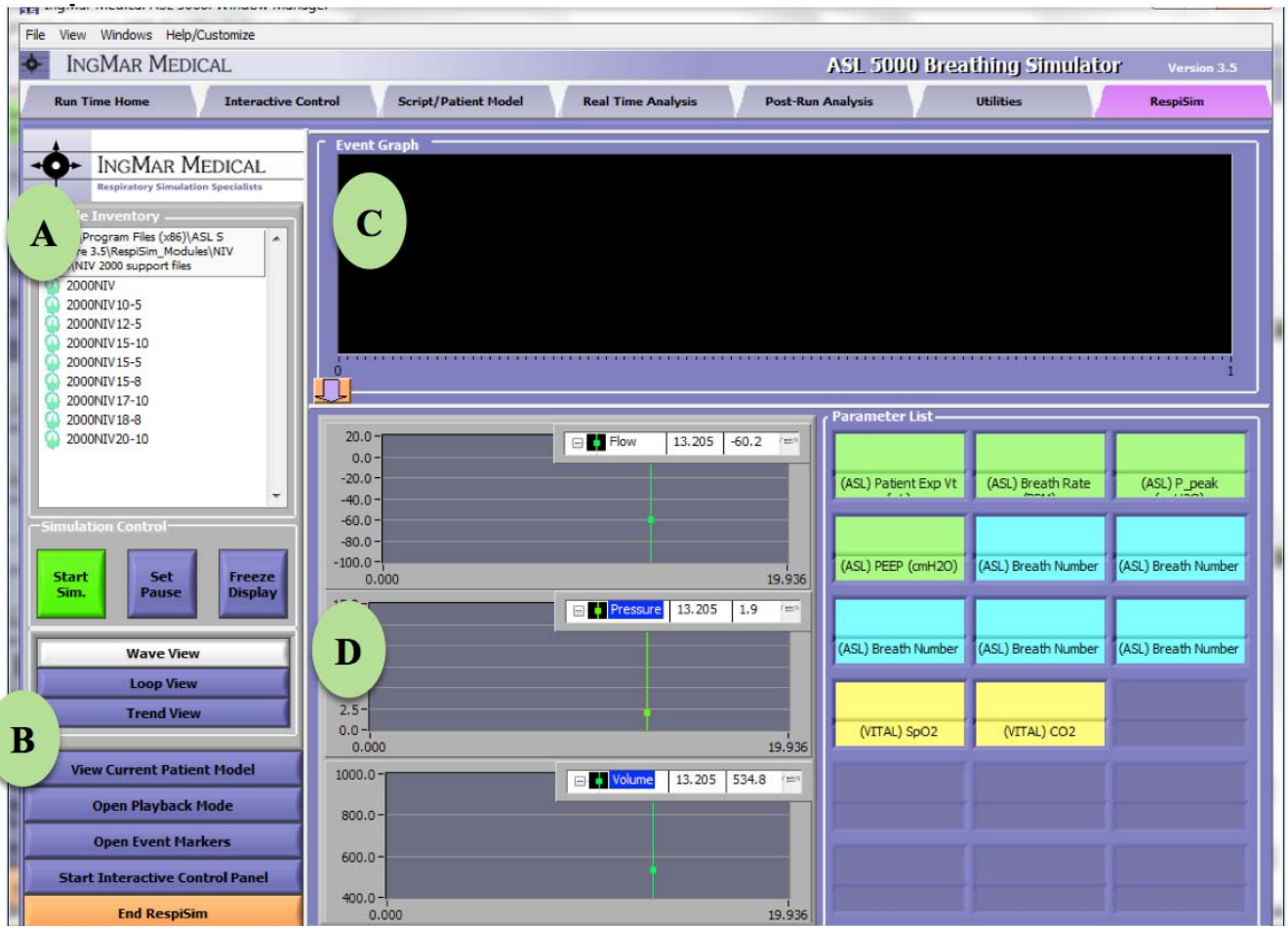

Figure 1-2 RespiSim Debrief Window

A: Module Inventory – Displays the available patient models created for a RespiSim module (e.g. NIV2000)

B: Control and Navigation Buttons – Start/Stop simulation, invoke pause patient model, and freeze the display for review. Adjust between Waveform, Loop, or Trend view. View current patient model. Open event markers window. Open the recorded simulation via the <Open Playback Mode> button. Navigate to the ***Interactive Control Panel***.

C: Event Graph – Shows each breath based on Vt, event markers invoked by the instructor (e.g. "O2% increased"), and any alarms or automated changes to a ventilator (VIK option) or to the ASL 5000 simulator.

D: Real Time Graphics - Real time graphics are provided in the ***RespiSim Debrief*** panel as either a complement of waveforms or loops (for pressure, volume, and flow), or trends of a selection of the numerically displayed parameters.

E: Numeric Parameters - Display up to 18 parameters collected from the ASL 5000, the attached ventilator (VIK option), and the simulated ***Vital Signs Monitor*** (VSM).

1.3 RespiSim Window in Playback Mode

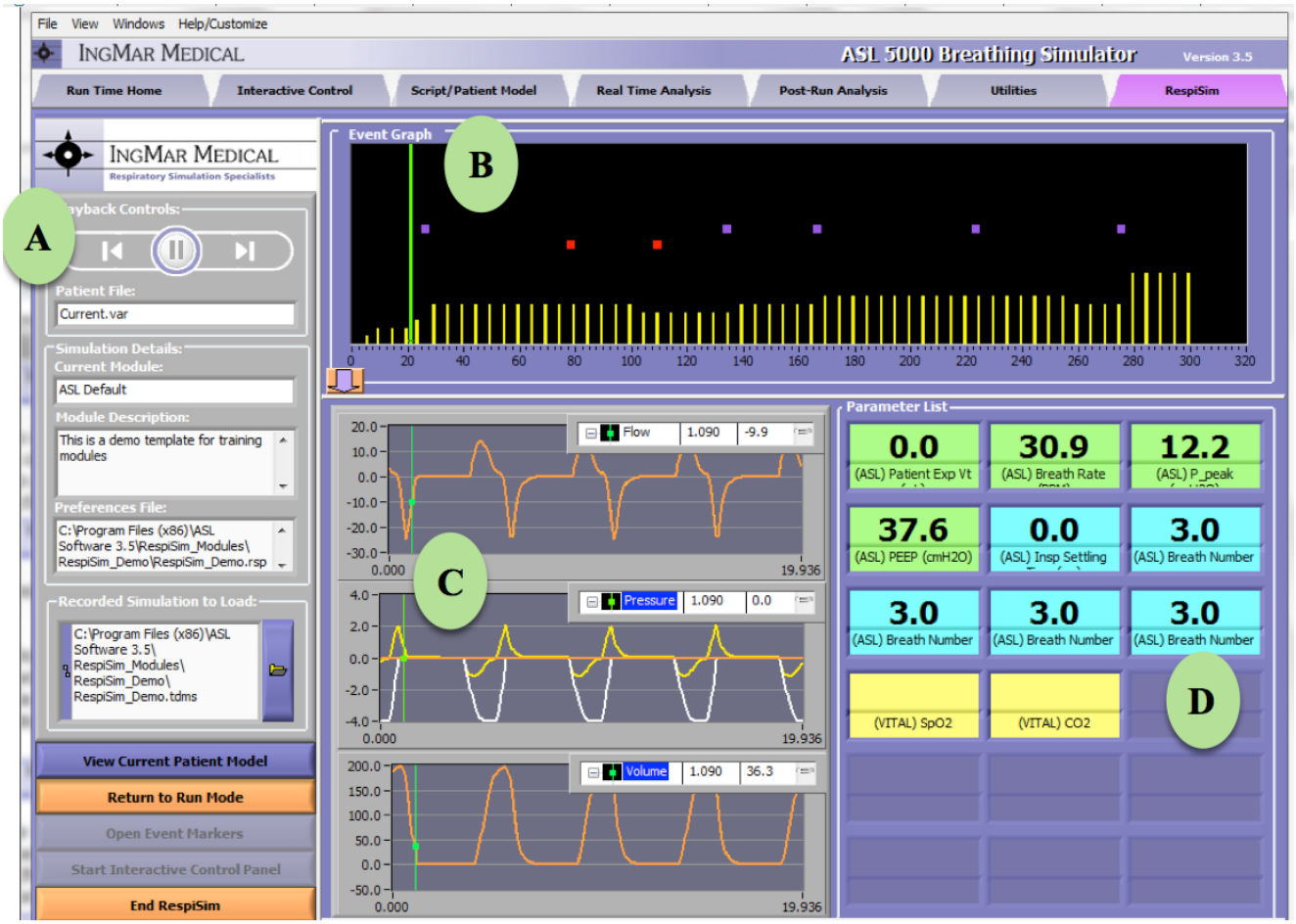

Figure 1-3 RespiSim Window in Playback Mode

The ***RespiSim*** tab on the ASL 5000 host software's Window Manager provides a coherent and full featured debriefing screen that brings together all relevant information from a simulation session.

A: Open Playback Mode - When the <Open Playback Mode> button in the control area of the RespiSim interface window is clicked, the visual appearance of the left portion of the window changes and all the pertinent information for the recorded simulation is displayed, together with a play/end-of-track/beginning-of-track set of buttons.

B: Event Graph - The Event Graph (or time line view) shows the entire simulation based on each breath (yellow bars) and any documented changes from the EventMarkers. The green vertical cursor can be moved throughout the simulation timeline to different positions that reveal the associated parameters, waveforms, and events at various points in the simulation.

C: Real Time Graphics - Real time graphics are provided in the ***RespiSim Debrief*** panel as either a complement of waveforms, loops, and trends of a selection of the numerically displayed parameters.

D: Numeric Parameters - The field on the bottom right of the ***RespiSim Debrief*** panel allows the display of up to 18 parameters collected from the ASL 5000, the attached ventilator, and the simulated vital signs monitor (VSM).

1.4 Vital Signs Monitor (VSM)

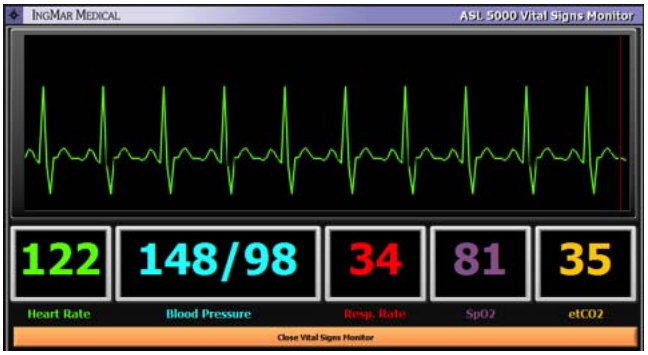

Figure 1-4 Vital Signs Monitor

The Vital Signs Monitor displays several vital parameters to the learner, but is also capable of displaying X-rays, ABGs, and lab results, upon request.

1.5 Event Marker Window

Figure 1-5 EventMarker Window

The ***EventMarker*** window allows the user to add debrief points to the simulation in real-time. When the student makes an adjustment to the patient, e.g. increasing the O2%, the instructor can mark on the Event Graph when this happened. The instructor can also toggle the marker to remain on (or latched) during a procedure (e.g. suction), creating a time line in the Event Graph indicating the duration of the procedure.

1.6 RespiSim Preferences Window

The ***RespiSim Preferences*** window gives the user the ability to configure the module visibility prior to running the simulation.

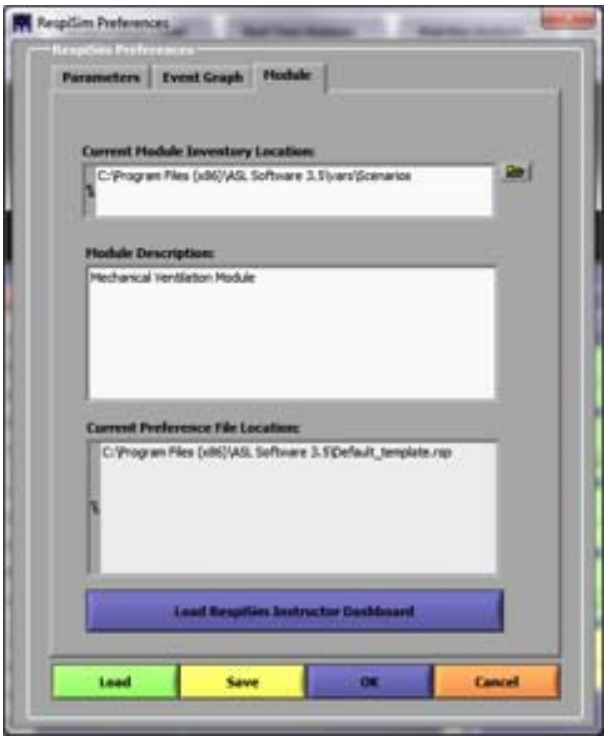

Figure 1-6 RespiSim Preferences - Module Tab

1.7 Module Tab

In this tab, the instructor can define the path for the **.vr3* patient profiles used in the simulation, provide a short description of the module, and define the path to the saved preferences file in **.rsp* format.

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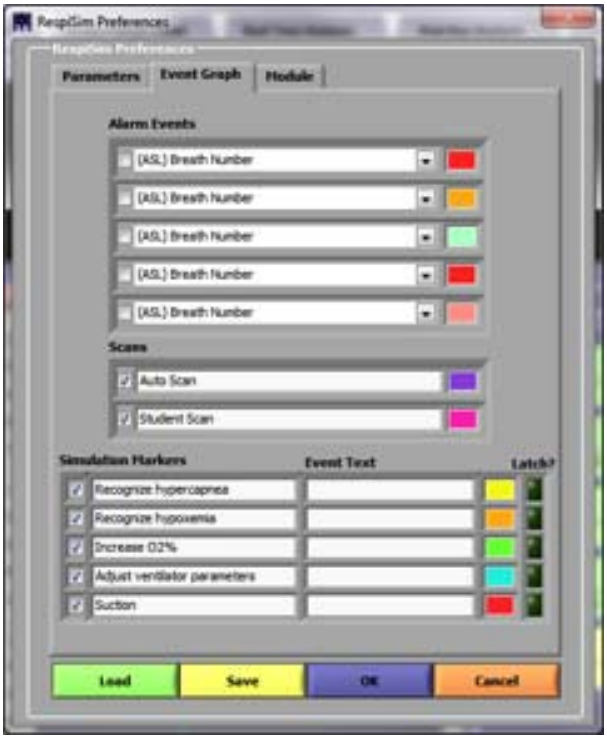


Figure 1-7 RespiSim Preferences - Event Graph Tab

Event Graph Tab - In this tab, the instructor can choose to include the automatic responses from the VIK (option, AutoScan), allow manual data charting from ventilator (Student Scan), as well as set the text labels for the ***EventMarkers*** window. Background colors and the ability to "latch" events are also configured in this tab.

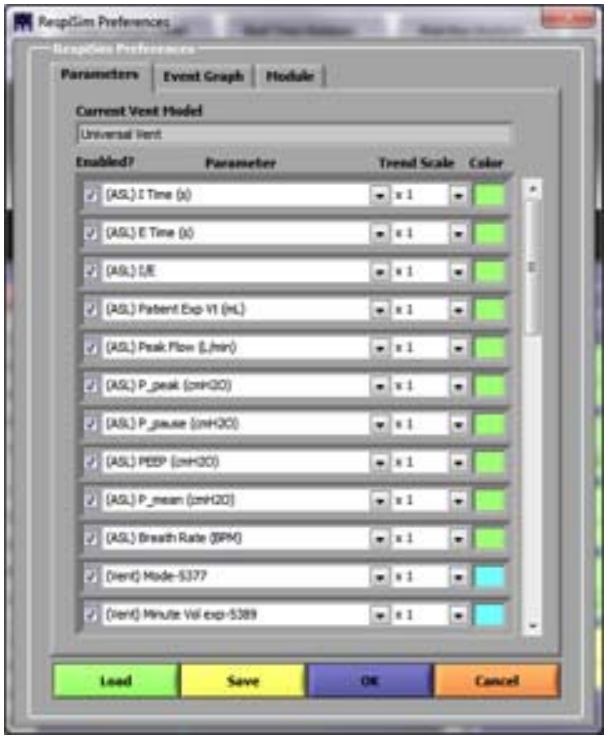


Figure 1-8 RespiSim Preferences - Parameters Tab

Parameters Tab - In this tab, the instructor can define up to 18 visible parameters for the ***RespiSim Debrief*** window. The colors of the parameter fields and any scaling can also be defined in this tab.

2 Plug & Play Modules

Most preconfigured curriculum module/packages supplied by IngMar Medical are accompanied by a Scenario Concept Presentation (SCP) that prepares students for the immersive hands-on simulation. The slide presentation is in a movie format (mp4) and has a full voice-over for self-study. It can be accessed in the module specific folder.

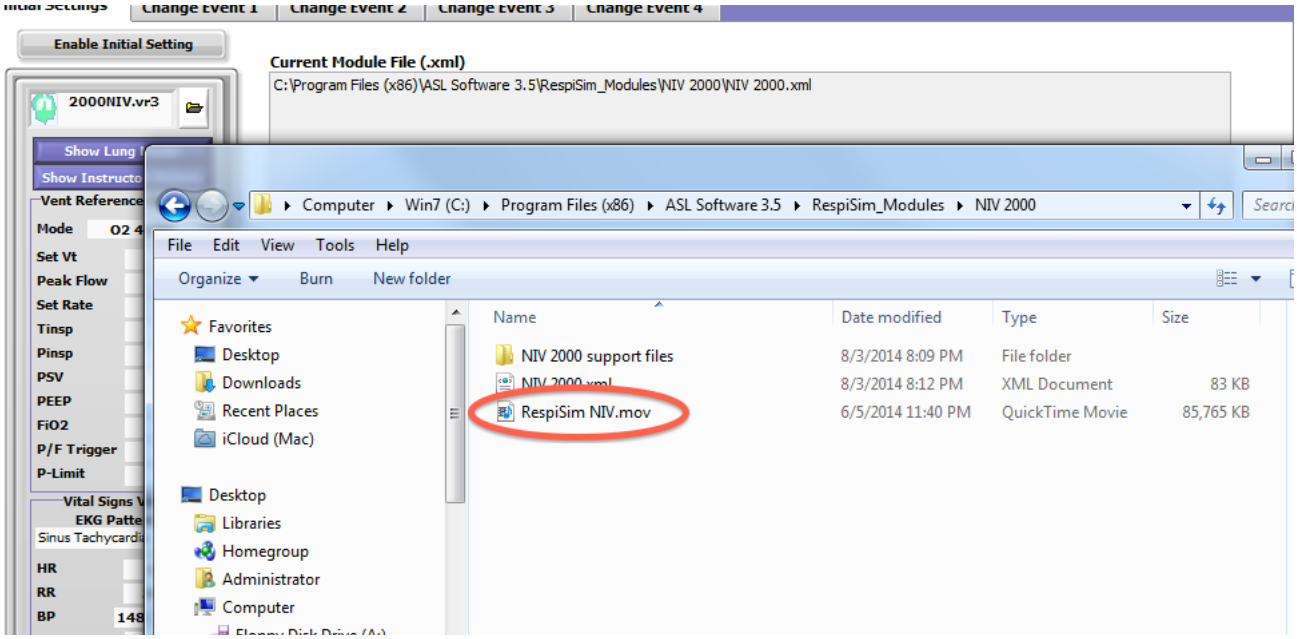


Figure 2-1 RespiSim Window in Playback Mode

3 Getting Started with RespiSim

NOTE: This section assumes that the user has a basic understanding of running the ASL 5000 Breathing Simulator with the ASL 5000 Software.

NOTE: The RespiSim option can run in demo mode in the same way as the main software. This can be useful in setting up modules and testing different patient transitions, etc.

After starting the software that will create the connection to the ASL 5000, select the ***RespiSim*** tab in the Windows Manager and click the Start RespiSim button.

This will first open the ***RespiSim Debrief*** window, and then the ***Instructor Dashboard*** window.

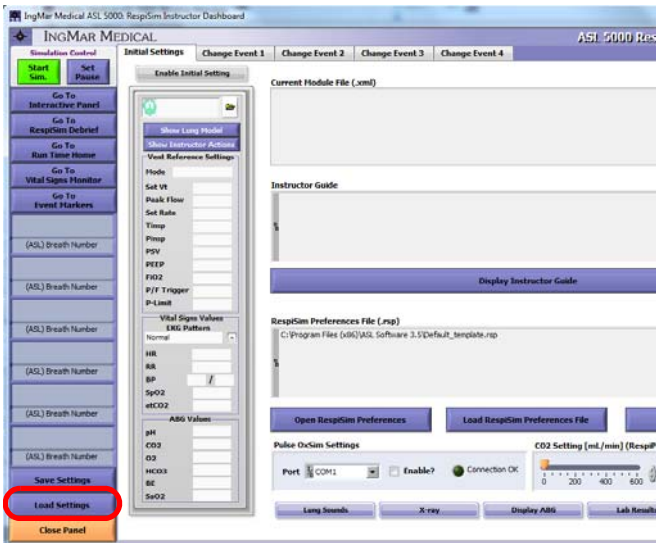


Figure 3-1 Instructor Dashboard After Start

Click on the Load Settings button.

This will allow the user to upload a RespiSim module from the RespiSim module inventory (default location).

Click on the file *filename.xml* to load a module. By default, the RespiSim modules are located in the *C:\Program Files (x86)\ASL Software 3.5\RespiSim_Modules* folder. Select and open the desired simulation folder, then double-click the *filename.xml* file for that simulation (e.g. *NIV2000.xml*).

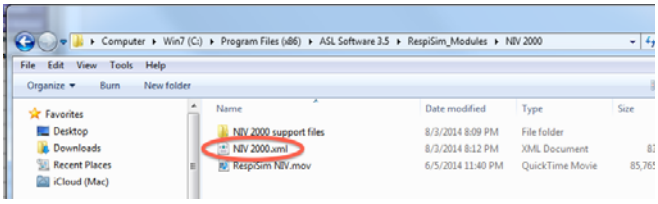


Figure 3-2 Selecting a RespiSim Module

The module's settings will now appear in the ***Instructor Dashboard's*** various tabs (e.g. Initial Settings, Change Event 1, etc.).

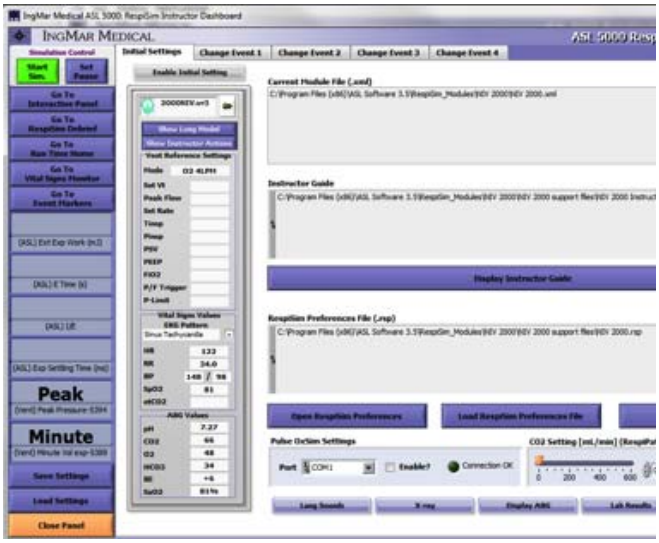


Figure 3-3 Instructor Dashboard After Module Loading

All of the patient profiles (.vr3 files) used for this module can now be seen in the "Module Inventory" field of the ***RespiSim Debrief*** Window..

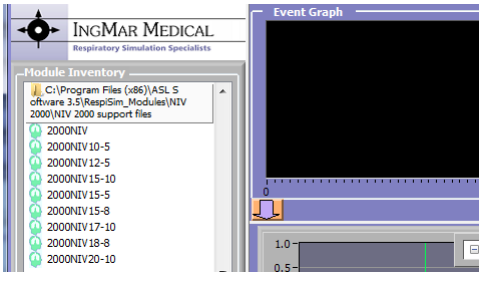


Figure 3-4 Module Inventory on Debrief Window

To show the Instructor Guide, click on the

button on the Instructor Dashboard. The Instructor Guide provides all of the information necessary to set up and facilitate a simulation according to the learning objectives. The instructor guide is a PDF document and requires Adobe Reader to open.

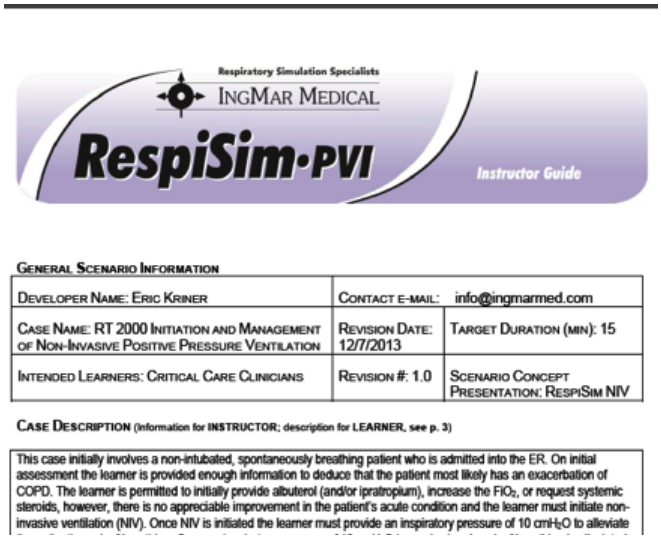
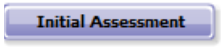


Figure 3-5 Instructor Guide

To show the patient's background information, click the



button near the bottom right of the ***Instructor Dashboard***..

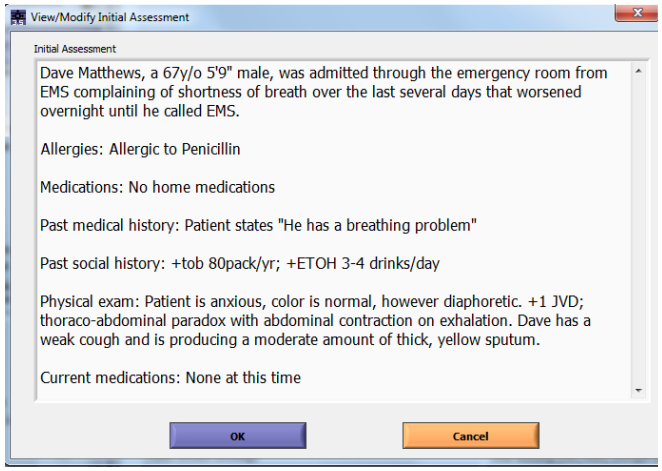


Figure 3-6 Initial Assessment

To gain a better understanding of what the learner should recognize during the simulation, click on the

button inside the **Initial Settings tab**.

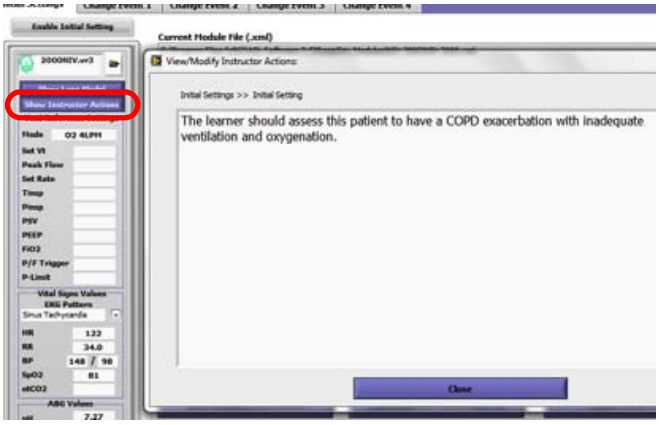
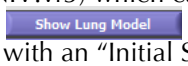


Figure 3-7 Instructor Actions

To start a simulation, click the

button on the Instructor Dashboard. This loads the initial patient model (e.g. 2000NIV.vr3) which can be examined by pressing the



button. The button changes to yellow with an "Initial Settings Enabled" label. The purple "streaking" bar above the ***Initial Settings*** tab shows which Event tab is currently running.

Click the

button to start the simulation.

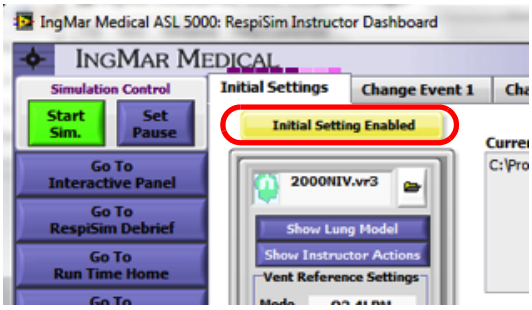


Figure 3-8 Enabling Initial Settings

When the "Select An Output File" window opens, enter path and a meaningful file name for data results file sets. You may direct the output files to the specific module's Support Files folder (e.g. *NIV 2000 support files*) or into a different folder of your choice. This results data will be used for debriefing later. Click "OK" to start the simulation.

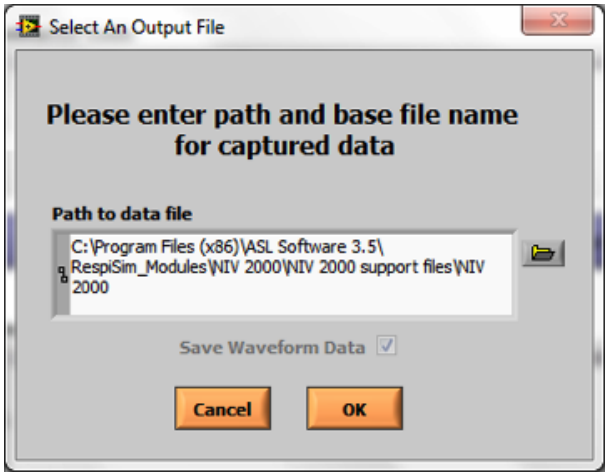


Figure 3-9 Saving a Data Set

Any time before or during the simulation, the instructor can display the Vital Signs Monitor (VSM) by clicking the

button on the Instructor Dashboard.

NOTE: A 2nd monitor is highly recommended for a realistic teaching environment. The software window for the VSM is sized to fill a 1366 x 768 screen (FWXGA).

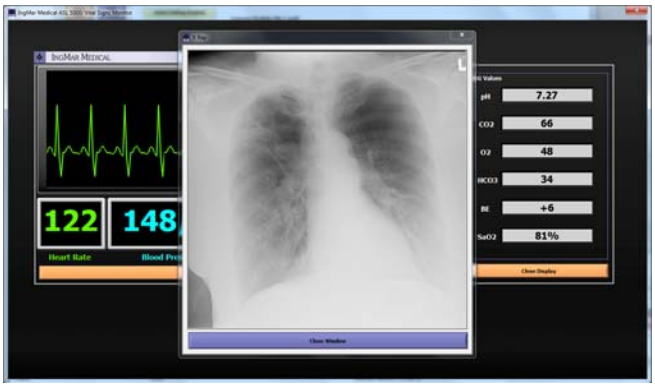
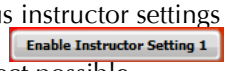


Figure 3-10 VSM Screen with ABG

As mentioned above, the instructor can also provide additional information such as X-ray images, ABGs, and lab results to the learner by clicking the

buttons.

Click the ***Change Event 1*** tab, next to the ***Initial Settings*** tab, to view how the instructor can control the further simulation sequencing. Here, various instructor settings can be enabled with the click of the



button. These instructor settings reflect possible treatment decisions made by the learner (e.g. changing ventilator settings) and the associated changes in patient status. The "red to green" background color scheme symbolizes the transition from the least to the most optimal treatment modality at that stage of the scenario. It should be noted that, for a successful conclusion of a simulation stage (the Change Event), the instructor will always have to ensure that the learner arrives at the "green end" of the spectrum; otherwise it would not make sense to proceed with subsequent Change Events.

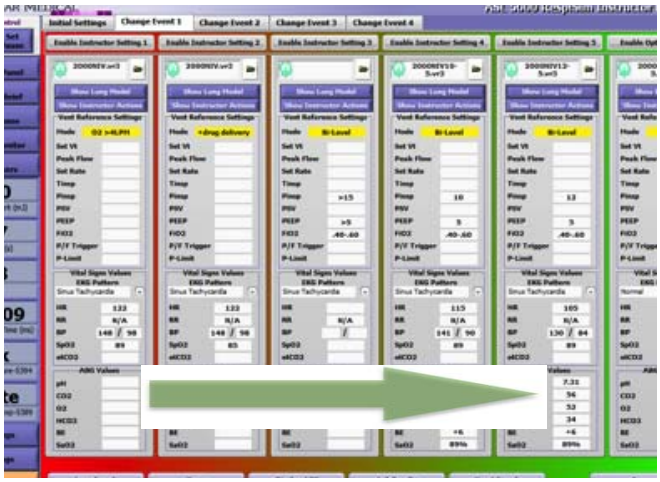
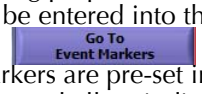


Figure 3-11 Change Event Progression

NOTE: For debriefing purposes, the changes made by the learner should be entered into the ***EventMarkers*** window. Click the



button to open the window. Event markers are pre-set in the module-specific preferences and allow individual notes to be entered in the fields provided. In some modules, these

notes may contain questions the instructor can use to test the learners' knowledge and enter additional text (the answers) into the fields.

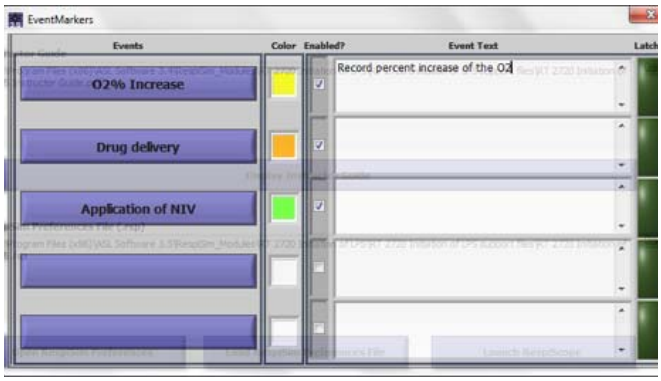


Figure 3-12 EventMarker Entries

To review the concluding notes for a ***Change Event*** tab, click the Assessment button at the bottom right of the Debrief Window.

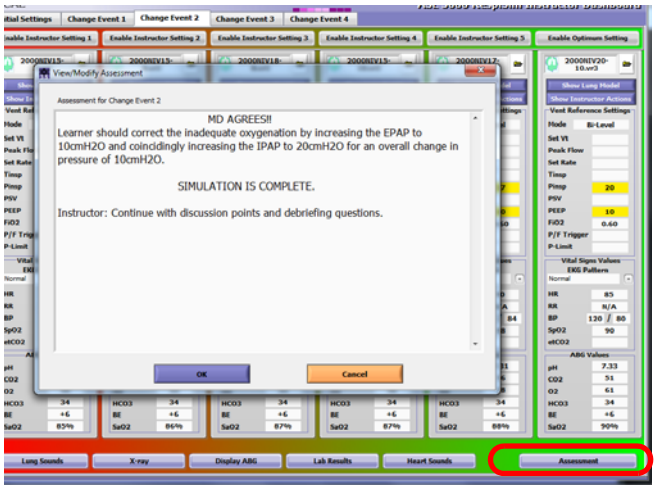
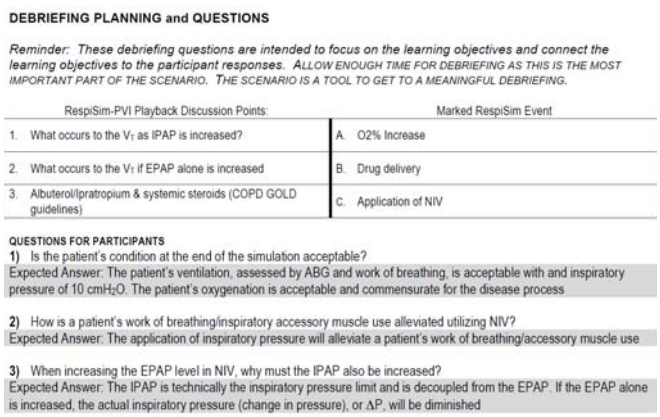


Figure 3-13 Final Assessment

Once the simulation is complete, the instructor can go to the RespiSim Debrief window to review the simulation. Go to the ***Initial Settings*** tab, and click the Display Instructor Guide button to view the Instructor Guide document. Scroll to the bottom of the document to find discussion materials, questions, and debriefing points



DEBRIEFING PLANNING and QUESTIONS

Reminder: These debriefing questions are intended to focus on the learning objectives and connect the learning objectives to the participant responses. ALLOW ENOUGH TIME FOR DEBRIEFING AS THIS IS THE MOST IMPORTANT PART OF THE SCENARIO. THE SCENARIO IS A TOOL TO GET TO A MEANINGFUL DEBRIEFING.

RespiSim-PVI Playback Discussion Points:	Marked RespiSim Event
1. What occurs to the V_T as IPAP is increased?	A. O2% Increase
2. What occurs to the V_T if EPAP alone is increased	B. Drug delivery
3. Albuterol/Ipratropium & systemic steroids (COPD GOLD guidelines)	C. Application of NIV

QUESTIONS FOR PARTICIPANTS

1) Is the patient's condition at the end of the simulation acceptable?
Expected Answer: The patient's ventilation, assessed by ABG and work of breathing, is acceptable with and inspiratory pressure of 10 cmH_2O. The patient's oxygenation is acceptable and commensurate for the disease process

2) How is a patient's work of breathing/inspiratory accessory muscle use alleviated utilizing NIV?
Expected Answer: The application of inspiratory pressure will alleviate a patient's work of breathing/accessory muscle use

3) When increasing the EPAP level in NIV, why must the IPAP also be increased?
Expected Answer: The IPAP is technically the inspiratory pressure limit and is decoupled from the EPAP. If the EPAP alone is increased, the actual inspiratory pressure (change in pressure), or ΔP, will be diminished

Figure 3-14 Instructor Guide: Debriefing Q&A

Click the Go To RespiSim Debrief button on the Instructor Dashboard to open the ***RespiSim Debrief*** window. From the ***RespiSim Debrief*** window, click the Open Playback Mode button.

The visual appearance of the left portion of the window changes and all the pertinent information from a recorded simulation can now be displayed, together with a play/end-of-track/beginning-of-track set of buttons.

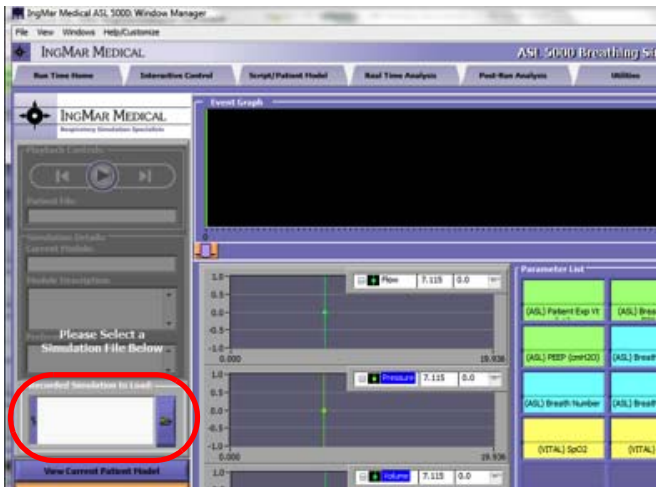


Figure 3-15 Starting Playback for Debriefing

Open a recorded simulation by clicking the folder browse button on the left of the window.

Browse to the appropriate **.tdms* file to open all the features of the recorded simulation module.

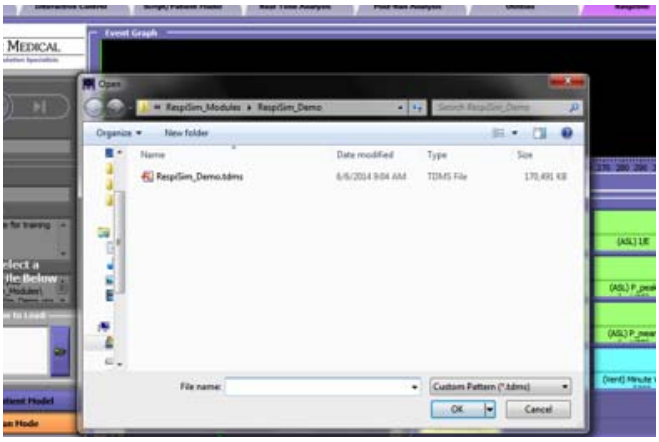


Figure 3-16 Selecting a **.tdms* File for Debriefing

Click the play button. 

Use the end-of-track/beginning-of-track buttons for easy navigation to the first or last use of a specific patient model (**.vr3*-file) during a simulation. The cursor in the Event Graph will be placed in this location so that waveforms and numeric values can be read off at transitions between different patient states with ease.

The height of the yellow bars in the Event Graph represents variations in tidal volumes. The colored blips represent events that have been recorded by the instructor for debrief points.

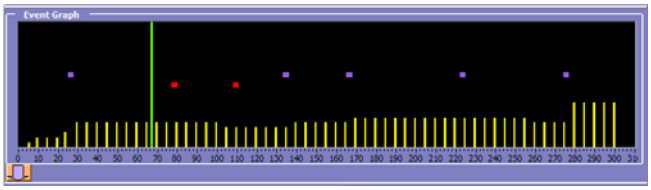


Figure 3-17 Event Graph During Debriefing

Aside from any events the instructor might enter during a simulation via the ***EventMarker*** window, there are several other markings in the Event Graph. From the top, these are markers for the automatic and student scans as they occur during the simulation. Below these, there is a maximum of five possible alarm-related marking bars. These are associated with ventilator alarms and indicate, for example, the existence of an alarm condition, operation of the ventilator's alarm silence function, or use of the alarm reset button. The alarm states and the autoscans or studentscans are available only with the VIK option. All other events can be invoked during any simulation and can be set via the RespiSim Preferences window, accessed via the ***Instructor Dashboard*** and the ***RespiSim Debrief*** window.

In playback mode, a vertical cursor is used for navigation. The Event Graph will always show the full length of the recorded simulation, but the Real Time Graphics (waveforms and loops, see below) are limited to the 20 seconds around the location of this cursor on the time line. Similarly, the numeric parameters shown are those from the time associated with the cursor position. Moving the cursor to different positions based on visual clues in the Event Graph will thus reveal the associated parameters, waveforms, and loops for that time.

The Event Graph can be enlarged to cover the full height of the RespiSim window by clicking on the down-arrow  in the bottom left of the field.

In this view, all bars are labeled for better orientation. Clicking on the up-arrow in the same location as before will collapse the field to its regular size.

Figure 3-18 Cursor "Hovering" for Marker Details

While the Event Graph is expanded, placing the cursor over the Instructor Events marked in the file ("hovering") will bring up any comments that had been recorded with the specific event.

The Event Graph shows a vertical cursor line that is used to navigate inside a selected recording. This is the primary method of accessing a particular point in time of a recording. The play button on the top left also has a step back/forward feature. Clicking on these elements forwards the starting point of the playback to the next (or

previous) change of patient parameter file. Clicking the <Play> button starts recorded data from the point of the cursor. The numeric parameters in the field on the bottom right change as the recording moves along, and so do the waveforms/loops in the Graphics field. Playback provides an excellent way for viewing data for the purpose of debriefing after a simulation session or to demonstrate effects in the context of e-learning, as a stand-alone. Real time graphics are provided in the ***RespiSim Debrief*** window as either:

— a complement of waveforms for flow, pressure, and volume
— flow/volume and pressure/volume loops, or
— trends of a selection of the numerically displayed parameters

In playback mode, data will always be visible only in the format in which it was collected (waveforms, loops, or trends). The time-length of the window for waveforms is determined by the choice made in the Run Time Home window (default is 20s). Loops are, by default, not auto-scaled, similar to the loops found in the Run Time Home window. The trend view is configurable from the graphics field itself, by clicking on the “Select Trends” button at the bottom. The trends of any of the numeric parameters displayed to the right of the graphics field as part of the Parameter List may be switched on or off, including a choice for “all off” or “all on.”

The field on the bottom right of the RespiSim interface window allows the simultaneous display of up to 18 parameters collected from the ASL 5000 internal calculations, the physical ASL 5000 parameters, attached ventilator (VIK option only), and Vital Signs Monitor.

Because of space constraints, the label text of the parameters might exceed what is visible in the respective field under the numeric value. Hovering over any of the label fields, however, will reveal the full name and physical unit of parameters in a “bubble.”

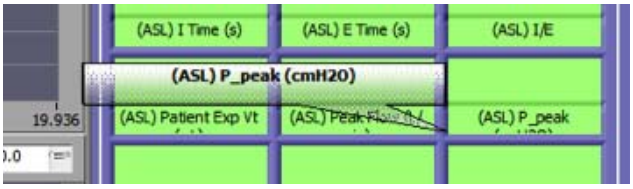


Figure 3-19 Parameter Labels on Debrief Window

Significantly, the parameters include not only breath parameters such as tidal volume or peak pressure, but also ventilator mode and alarm settings as well as patient status vitals (click on the field names to see the many choices in a drop-down menu).

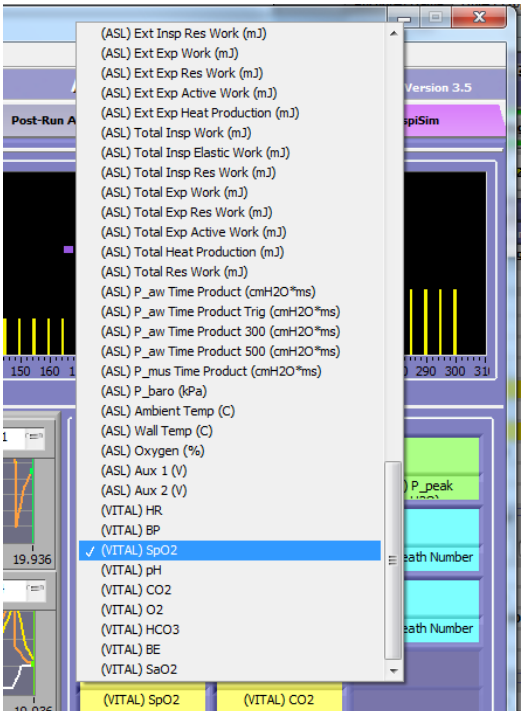


Figure 3-20 Selecting a Parameter for Debriefing

Since ventilator parameters are generally retrieved based on the AutoScan settings, and are only updated every 20 or 30 seconds, the values are not quite real time. For this reason, it is recommended to always give priority to parameters coming directly from the ASL 5000 Breathing Simulator when possible. These parameters are calculated for every breath and can provide more timely information in cases where a particular parameter is available from both the simulator and the ventilator (e.g. tidal volumes, peak pressures, etc.).

The parameter fields may be populated with any of the 90+ breath parameters. The color background of these parameter fields can be adjusted based on user preference. To change the background colors, open the RespiSim preferences window from the Dashboard or the Debrief view. Colors can be used to group parameters of the same type together (e.g. parameters from the ASL 5000, the ventilator, and the Vital Signs Monitor).

4 Authoring Modules

IngMar Medical has developed complete modules ranging from understanding modes of ventilation to more specific topics like dissynchrony. As an instructor becomes more familiar with the RespiSim concept, custom modules can be created and submitted to IngMar Medical for review.

As stated above, the learning goal is to help the learner arrive at the optimal settings based on the definition of the module. As the learner makes adjustments to a ventilator based on the patient model and vitals feedback, the instructor can then enable new patient models (from left to right in a ***Change Event*** tab). As the simulations become more complex, the instructor can add new ***Change Event*** tabs with changing patient models in an effort to guide the learner to the optimal outcomes.

The recommended method for creating a custom module is shown below.

4.1 Instructor Guide

An Instructor Guide Template & Authoring Guide is provided to outline the steps the instructor must take for the preparation of RespiSim modules. The Instructor Guide provides the following:

- General Scenario Information
  —Information about the module, developer, Intended learners
- Case Description
  —Summary of the background of the patient and the environment for the upcoming simulation
- Learning Objectives
  —A listing of the objectives expected by the learners
- Scenario Overview
  —Includes the Initial Assessment and Change Events to be used
- Patient Information and History
  —Details about age, setting, history, vitals, labs, etc.
- Initial Assessment
  —Detailed assessment and files used in the simulation in the Initial Settings Tab
- Change Events
  —Breakdown of each Instructor Setting group within a given Change Event. This covers vent reference settings, lung models to use, vitals, etc.
- Debriefing Planning and Questions
  —Information on preparing for the debrief session and what pertinent questions should be asked at the conclusion of the simulation and debrief.

4.2 Saving Settings

It is good practice to frequently save settings while setting up the RespiSim modules. The format of the module is in **.xml* format. By clicking the Save Settings button on the Dashboard, the instructor can save and overwrite the simulation file until the module development is complete. When the **.xml*-file is saved, a support files directory is automatically created that holds all of the patient models, lab results file, instructor guides, etc. for that module. Because of this, it is recommended to create a new folder inside the *..\RespiSim Modules* directory where the **.xml*-file and all files for this module (support directory) will be saved while building the simulation.

We recommend to give the **.xml*-file the same name as the folder that is created within the *..\RespiSim Modules* directory as shown below.

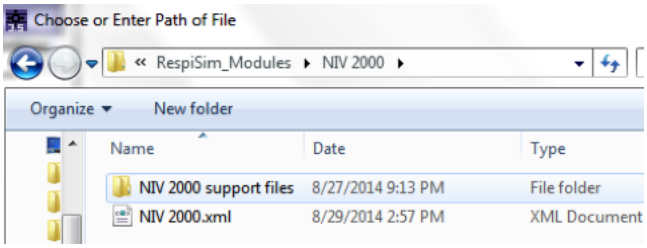


Figure 4-1 Module File Naming

4.3 Instructor Settings Columns

The event tabs encompass several Instructor Settings columns which hold the characteristics of each step of a patient scenario. The user should always start with the ***Initial Settings*** Tab. Each column can be populated in the four additional ***Change Event*** tabs based on the module being created.The instructor can fill each individual column with vent reference settings (the ventilator settings expected for a particular state), vital signs and ABG values that pertain to the scenario.

Begin with an initial baseline and, based on these values, create different treatment pathways (vent settings) a learner may choose to manage the patient's status (vitals and ABG values). As you move from left to right (i.e., red to green), provide the least optimal to the most optimal treatment decision (vent settings) and how the patient's body reacts to these changes (vitals and/or ABG values).

Figure 4-2 Setting Values in the Columns of the Instructor Dashboard

4.4 Patient Models

The patient models (*.*vr3* files) are instructor-defined and -developed models to be used at different times during the scenario simulation. Patient models can be designed to include various compliance, resistance, and effort settings that represent the diseased or improving states of a patient while on the ventilator. Patient models can be passive and only respond to the ventilator, or spontaneously breathing, thus requiring synchrony in the ventilator settings. These models can be put into the Instructor settings columns on the ***Instructor Dashboard*** to represent the advancement of a patient's condition from initial state to final assessment.

To add a patient model to the simulation, click the folder icon at the top of each settings column. It is highly recommended to always start with the Initial Settings tab for the first state of the patient.

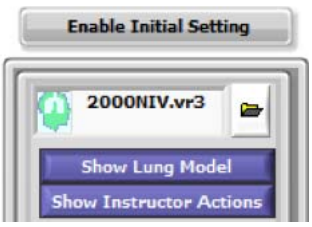


Figure 4-3 Adding Patient Models to RespiSim Modules

The instructor should develop each patient model before creating the RespiSim module. This is best done in the demo mode of the ASL 5000 software. Patient models can be designed and placed anywhere on a computer, but it is recommended to keep all *.vr3 files within the *..\vars* directory where the ASL 5000 software is installed for ease of searching for the new patient profiles.

4.5 View Lung Model

After a patient profile is added to the RespiSim environment, the instructor has the ability to verify the lung models used by clicking the Show Lung Model button in any of the settings columns. From this window, the instructor can edit the current model as needed by clicking the Edit Patient Model button. Please refer to the ASL 5000 User's Manual for information on editing a patient model.

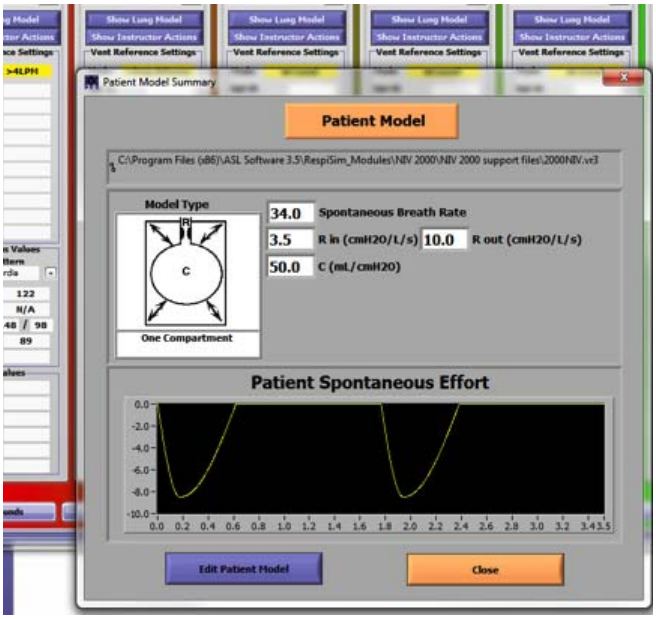


Figure 4-4 Building the Patient Model (R and C)

4.6 Right-Click Options

Right-clicking inside of any of the editable fields within the **Instructor Settings** columns enables several features.

Figure 4-5

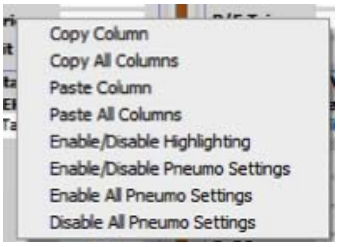


Figure 4-6 Right-Click Options on Instructor Dashboard

- **Copy Column** – Copy all data from a single column
- **Copy All Columns** – Copy all columns from a Change Event tab
- **Paste Column** – Paste copied data into a single column
- **Paste All Columns** – Paste data into all columns within a Change Event tab
- **Enable/Disable Highlighting** – Highlight specific parameters within a column
- **Enable/Disable Pneumo Settings** – Individual column tension pneumothorax control for the RespiPatient® option
- **Enable All Pneumo Settings** – All Change Event column tension pneumothorax control (enable) for the RespiPatient® option
- **Disable All Pneumo Settings** – All Change Event column tension pneumothorax control (disable) for the RespiPatient® option

4.7 Highlighting

It is good practice to highlight specific parameter changes as you progress through the scenario. In the plug-and-play modules, the vent settings that need to change in order for the patient to reach optimal status, are highlighted. Right click on any Instructor Settings column and the drop-down menu will appear. Click on the “Enable/Disable Highlighting” option. From the Parameter Highlight Configuration window, select the parameters you want to highlight with a check mark and click “Close” for the changes to take effect.

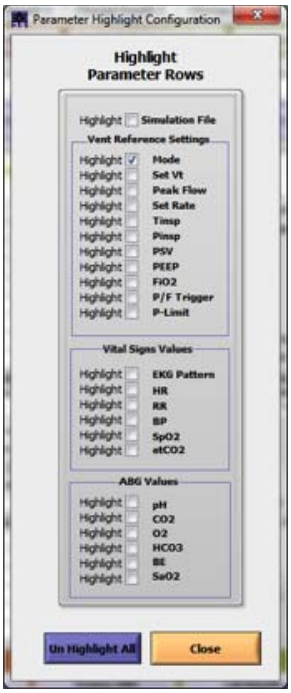


Figure 4-7 Highlighting Options on Instructor Dashboard

With **Mode** highlighting set for the ventilator reference settings, the result looks like this.

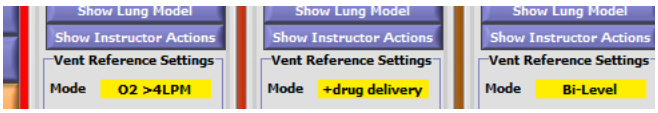


Figure 4-8 Vent Reference "Mode" Highlighting

4.8 Instructor Actions

The instructor can enter information into the ***Show Instructor Actions*** windows for all settings columns and Change Events. The information in each ***Instructor Actions*** window is based on the choices made by the learner. This is where the instructor or physician can agree or disagree with a treatment choice made by the learner. Comments entered here are also intended to coach the instructor on what to say or do depending on the information inside the window.

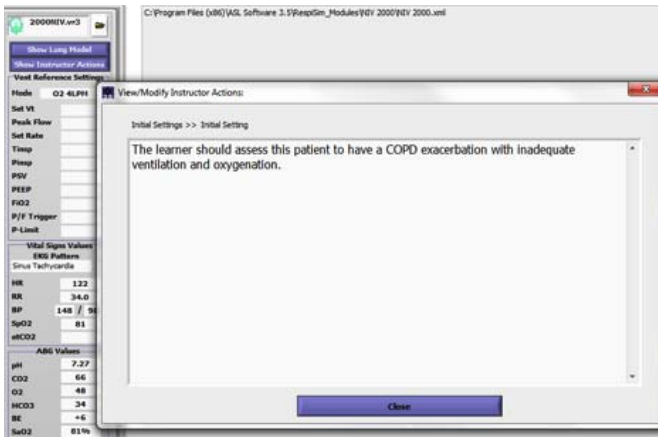


Figure 4-9 Authoring Instructor Actions

4.9 Lung and Heart Sounds

RespiSim provides two methods for working with lung and heart sounds. The first method is to add sounds to the View/Edit Lung Sounds and/or View/Edit Heart Sounds windows directly as **.wav* or **.au* files for playback from the PC's speaker. Right-clicking the Lung Sounds or the Heart Sounds buttons opens the edit window from the Instructor Dashboard. The user can add a description about the sound file in the ***Description:*** box. Clicking on the folder icon allows the instructor to browse for an appropriate sound file. The instructor can preview the sound directly from this window by clicking the play button inside the media player, or by clicking the Play Sound button. Clicking <OK> closes this window. During a simulation, the instructor can click the <Lung Sounds> or <Heart Sounds> buttons at any time to hear the sound. The computer running the simulation will need to have the volume and speakers on to hear these sounds. It may help to have external speakers when using this option.

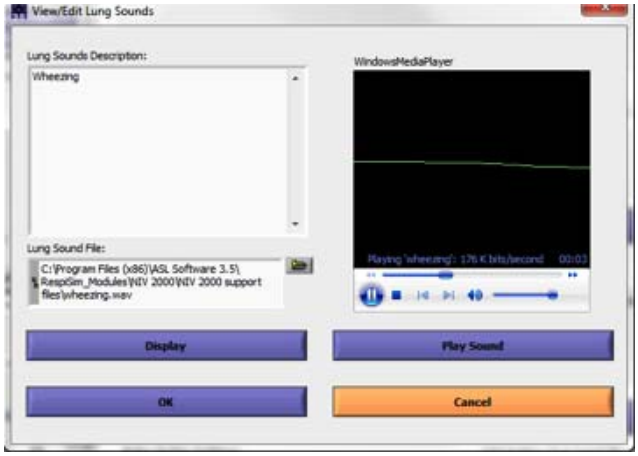


Figure 4-10 Authoring Scenario Sounds, Standard Method

The second method requires the IngMar Medical RespiPatient® option in combination with a dedicated Cardionics SimScope™. With this option, the user can run IngMar Medical's RespiScope™ software to manipulate nine different lung, heart, and bowel regions on the RespiPatient® manikin to provide realistic sounds directly to the learner via the SimScope™ stethoscope. The RespiScope™ software gives the instructor the ability to save specific sound file settings to a **.car* file, a playlist that assigns sounds to the nine listening regions of the RespiPatient® manikin. Similar to the first method, instead of loading a **.wav* file via the folder icon, the instructor would load the **.car* file.

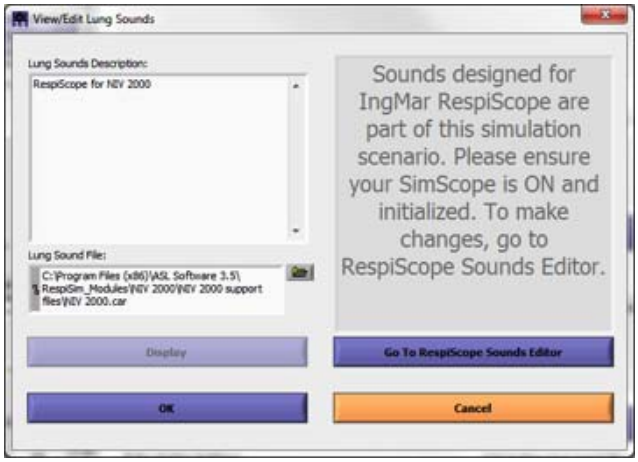


Figure 4-11 Authoring Sounds, RespiScope™ Method

The appearance of the ***Lung Sounds*** and ***Heart Sounds*** windows changes (see Figure 4-11, page 19) to allow the user direct access to the RespiScope software. The RespiScope™ software can also be opened directly from the ***Initial Settings*** tab via the Launch RespiScope button. To learn more about using the RespiScope software, please see the RespiPatient® manual.

4.10 Chest X-ray

Upload chest X-rays from your EMR system/archives as appropriate to allow learners to request them as additional information on patient status. The x-rays are available when the Vital Signs Monitor screen is open. The RespiSim software can use two image sizes based on instructor preference:

— Large X-ray – 600 x 600 pixels
— Small X-ray – 300 x 400 pixels

NOTE: Adding X-ray images to the RespiSim software is explained below using Microsoft Paint application:

Load the X-ray image file into Paint.
Click the ***Home*** tab and then select Resize. This opens the ***Resize and Skew*** window

Check the Pixels radio button to make sure the units are in pixels.
—When creating the Large image, set the horizontal and vertical values to 600 pixels.
—When creating the Small image, set the horizontal to 300 and the vertical to 400 pixels.

NOTE: Depending on the original image aspect ratio, cropping will be necessary to arrive at the required pixel counts without distortion. Remember that you can also add margins if cropping would eliminate important parts of the image.

Click <OK> and the image sizing is complete.

Perform a "Save As" and make sure to save the image as a **.jpg* and include the Large or Small notation for ease of loading into the RespiSim software.

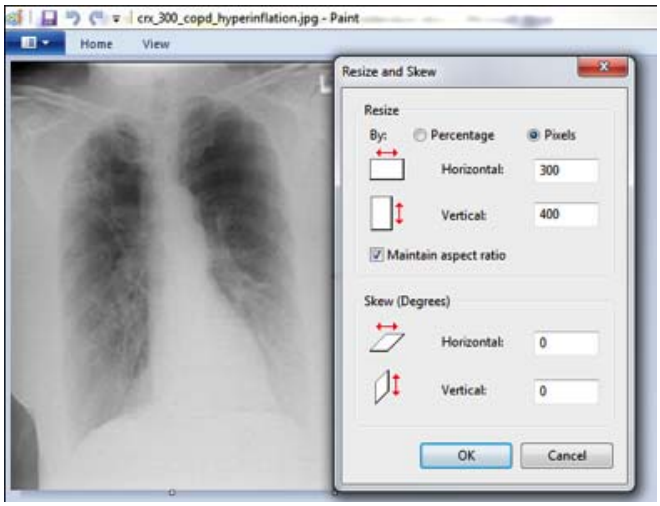


Figure 4-12 Sizing X-rays - 300 x 400 pixels

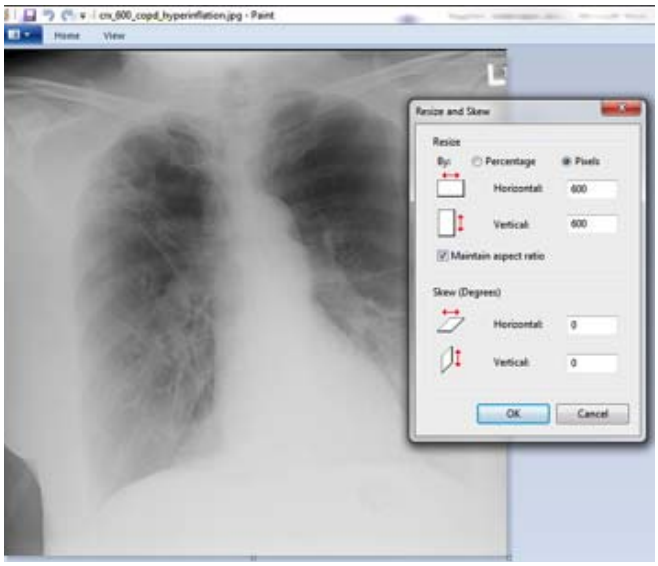


Figure 4-13 Sizing X-rays - 600 x 600 pixels

In the above example, the 300 x 400 pixel image is slightly distorted, because the original image was in a square format.

Loading the X-ray files into the RespiSim environment

1. Right-click on the X-ray button from the Instructor Dashboard. This opens the ***View/Edit X-ray Information*** window.

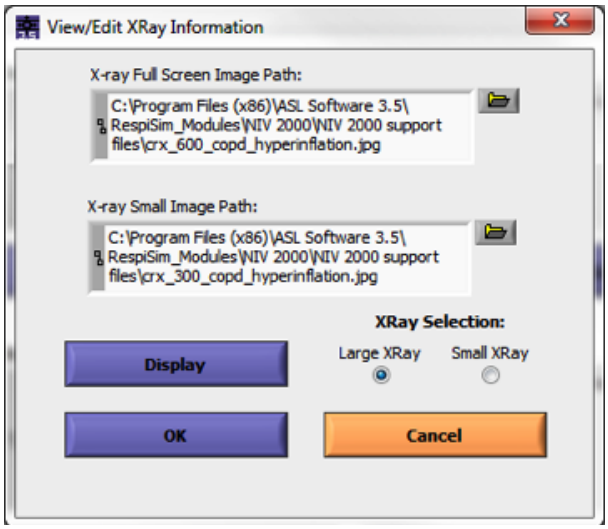


Figure 4-14 Viewing X-ray Images

2. There are two folder icons that are now used to load the Large (Full Screen) and Small images that were created previously.

3. Click either folder icon and load the appropriate images

4. Select the radio button Large XRay Small XRay to assign which image size the instructor should display as the default during simulations (it is not possible to show both images, but the choice can be reversed at any time later). The Large (Full Screen) image displays on top of the Vital Signs Monitor window.

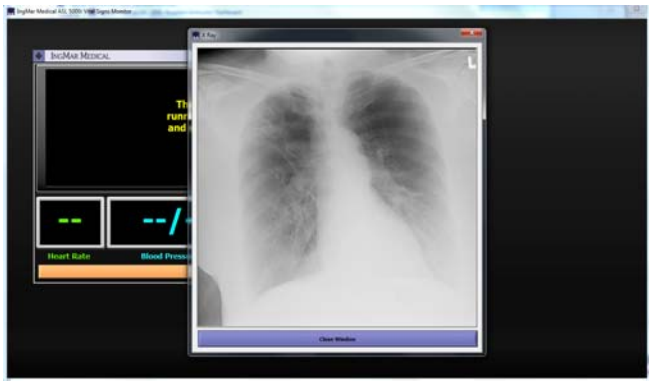


Figure 4-15 Large X-ray Image Display

The Small image displays to the right of the Vital Signs Monitor window.

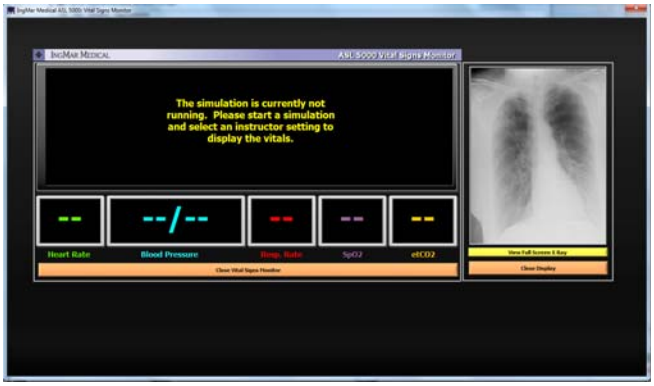


Figure 4-16 Small X-ray Image Display

5. Select <OK> to close the window.

4.11 Lab Results

Create lab results to allow learners to examine the use of laboratory tests for managing mechanical ventilation. Open a simple text editing application like Notepad on the IngMar Medical computer provided. Type the lab test name on the left (i.e. BUN) and then click the tab button on the keyboard once. Next, type the numerical value with correct units (i.e. 21 mg/dL). Click the Enter/ Return button on the keyboard to add another lab result. Save the lab results as a **.txt* file (i.e. *NIV2000labresults.txt*) in the module's support files directory.

File Edit Format View Help

BUN	21mg/dL
Cr	1.1mg/dL
Na	132mEq/L
Cl	99mmol/L
K	4.3mEq/L
CO2	32mmol/L
WBC	11.8
Hgb	14.8g/dL
HCT	43%

Figure 4-17 Lab Results Display

Right-click the Lab Results button from the Instructor Dashboard and select the lab results file by clicking the folder icon in the dialog window that opens.

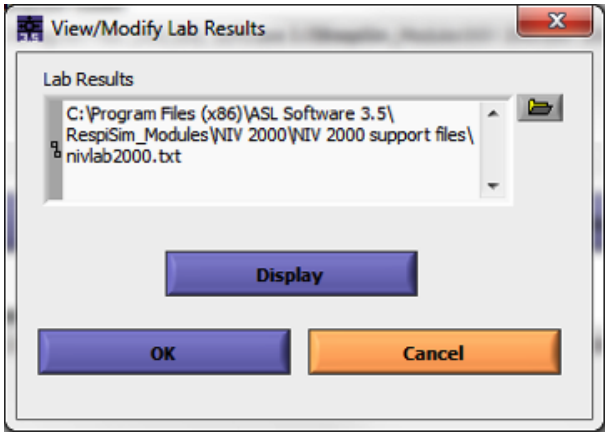


Figure 4-18 Lab Results Display

NOTE: For displaying lab results, the Vital Signs Monitor window will be opened.

4.12 ABG Values

The ABG values are entered directly into each settings column within the Dashboard Change Events. When a simulation is running, the ABG values are displayed from the column that is "Enabled." Upon a learner's request, the Vital Signs Monitor window can also display the ABG by clicking the Display ABG button.

Figure 4-19 ABG values Display

NOTE: For displaying ABGs, the Vital Signs Monitor window will be opened.

4.13 Assessments

The Instructor Dashboard's ***Initial Settings*** tab provides the Initial Assessment button. This button is intended to provide the learner with a complete patient health history in order to aid them in preparation for the patient encounter. In the plug-and-play modules created by IngMar Medical, background information is provided, which includes the following items:

— demographic data,
— chief complaint,
— history of present illness,
— past medical history,
— social and environmental history.

This information helps to provide a more accurate picture of the current patient. The instructor can use this window to provide similar details about the patient and the ensuing simulation when authoring. Simply enter the desired text into the window and click <OK>.

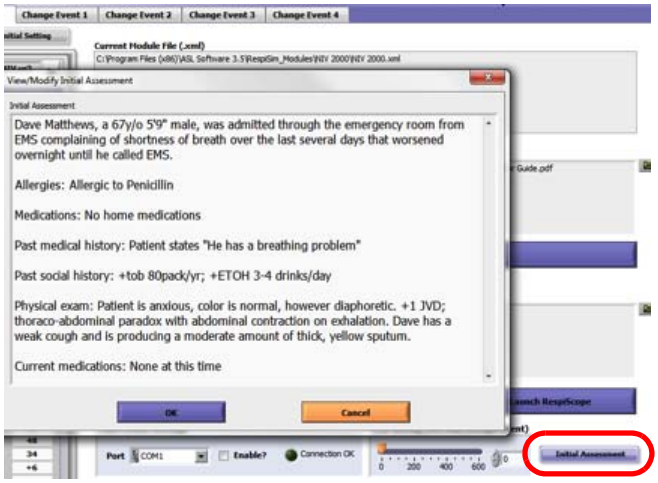


Figure 4-20 Initial Assessment Window

Each Change Event tab also incorporates an Assessment button where the instructor can provide feedback and/or directions for how to continue the simulation. For example, the learner may reach the Optimum Settings column in Change Event 1, leading to the following Assessment.

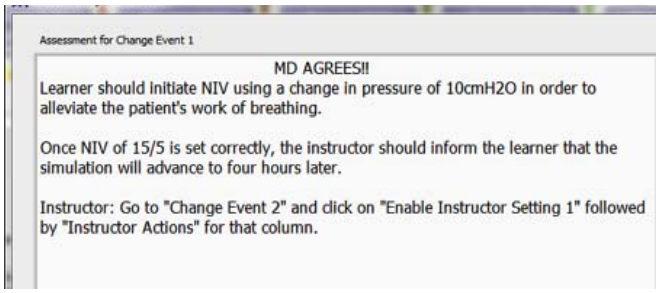


Figure 4-21 Change Event Assessment Window

4.14 Parameters on Instructor Dashboard

Customize modules by selecting up to six parameters (ASL, Vent, or Vital) visible to instructors on the Instructor Dashboard. Select parameters that are crucial to the progression of the specific simulation. For example, if a learner decides to initiate a lung protective strategy (LPS) on the ventilator (decrease Vt, increase RR), the instructor may want to have a visual of those setting changes (using either the 'ASL' or 'Vent' parameters) in order to know when to activate the patient model appropriate for the LPS.

These parameters are intended to assist an instructor who may not be present in the simulation room or have a direct view of the changes being made on the ventilator.

Click on the parameter drop-down to select from the list of 90+ parameters and remember to save the settings.

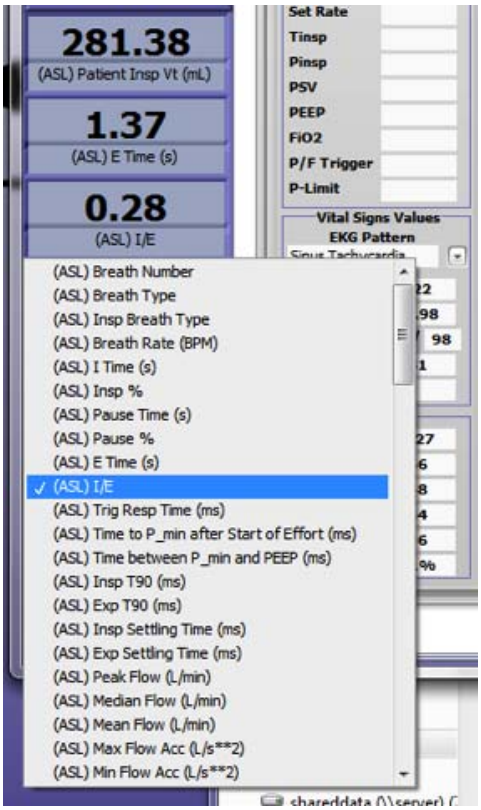


Figure 4-22 Selection of Parameters for Display on the Instructor Dashboard

5 The RespiSim Environment

Ventilator management is a critical responsibility that demands sophisticated skills. The RespiSim system is capable of providing a sophisticated training environment for many aspects of the tasks related to ventilator support. The mechanical ventilation curriculum in respiratory care programs has, of course, the most need for such training. On the other hand, other caregivers, such as physicians and nurses, also have to be trained in the basic handling of ventilators. They need to have the ability to recognize potentially dangerous events or challenging patient conditions. Scenarios for teaching those skills can be taught within the scope of the RespiSim system. The instructor's task is to create and implement exercises that will greatly enhance the depth and speed with which such skills can be learned.

5.1 Optional RespiSim VIK Hardware System Components

Aside from the RespiSim modules in the ASL 5000 host software, the RespiSim System comprises an optional hardware component, the Ventilator Interface Kit (VIK), that connects a "Bridge" directly to a ventilator's serial data port (please see specifications in the ASL 5000 User's Manual for a list of compatible ventilators). Additionally, a SQL database environment for the captured data coming from the Bridge is installed on the PC. This database is then accessed by RespiSim to make real ventilator data available for simulation exercises.

IngMar Medical has partnered with Bridgetech Medical, a specialist in electronic charting systems for respiratory care environments, to integrate data from a wide range of ventilator manufacturers. For more information on Bridgetech Medical solutions for electronic charting, please visit www.bridgetechmedical.com.

Figure 5-1 Typical attachment of VIK to Ventilator

5.2 Optional VIK Software Installation

If you purchased the optional VIK along with the RespiSim option for the ASL 5000, the installation of the database environment necessary for operation of the VIK has already been performed and the system is prepared for use.
With the VIK software installation, there will be two icons on the host computer desktop. The first is called the AutoScan app, the other is called the StudentScan.

Figure 5-2 AutoScan and StudentScan Icons

The AutoScan application performs, as its name implies, the frequent automatic scans of ventilator data that populate the database for ventilator parameters to be included into the simulation data sets.

The StudentScan application is a program that would be loaded onto a tablet device with infrared or WiFi capabilities when used in a real ICU environment for the purpose of patient charting. Both applications take snapshots of ventilator data, which, in the case of StudentScan, can also be augmented with annotations by the caregiver for properly qualifying a patient's status.

5.3 Optional VIK Hardware Setup

Components necessary for VIK:

- ASL 5000 and host computer
- Router with two or three Ethernet patch cables (depending on whether the user wants to use the VIK wirelessly or hard wired)
  NOTE: On the back of the router, only use ports 1-4 (never the internet port)
- Ventilator Interface Kit (VIK), consisting of
  —Fusion Bridge (black box) with power cord
  —Short Cat-5 Ethernet cable
  —Ventilator specific serial adapters
  —Blue/yellow USB-to-serial adapter combination (labeled as Fusion)
  —All power cords and supplies

Connections:

The VIK can be connected to the router as a wireless or hard-wired configuration (IngMar Medical recommends hard-wiring the VIK to the router).

Hard-wired configuration

a) Connect quantity three Ethernet cables to the back of the router, and then to the:
—IPC
—ASL 5000
—Fusion Bridge
b) Connect power cables to all four components.
—PC with power cord
—ASL 5000 with power cord
—Router with power cord (LEDs will blink once device is plugged in, there is no On/Off switch)
—Fusion Bridge with power cord (LED light on front of Fusion Bridge will light up, there is no On/Off switch)

Connect to ventilator

—Blue/yellow USB-to-serial adapter combination connects to the Bridge with its USB end.
—Connect short Ethernet cable from the VIK case to the other end of the blue/yellow adapter combination.
—Connect the other end of the Ethernet cable from the blue/yellow adapter combination into the appropriate ventilator specific adapter (see list in the VIK case or in the ASL 5000 User's Manual).
—Plug ventilator specific adapter into the communications port (Serial / MIB / LTV ports, etc.) on the ventilator (typically found in the back).

For an overview of the configuration, please see Figure 5-3 on the next page.

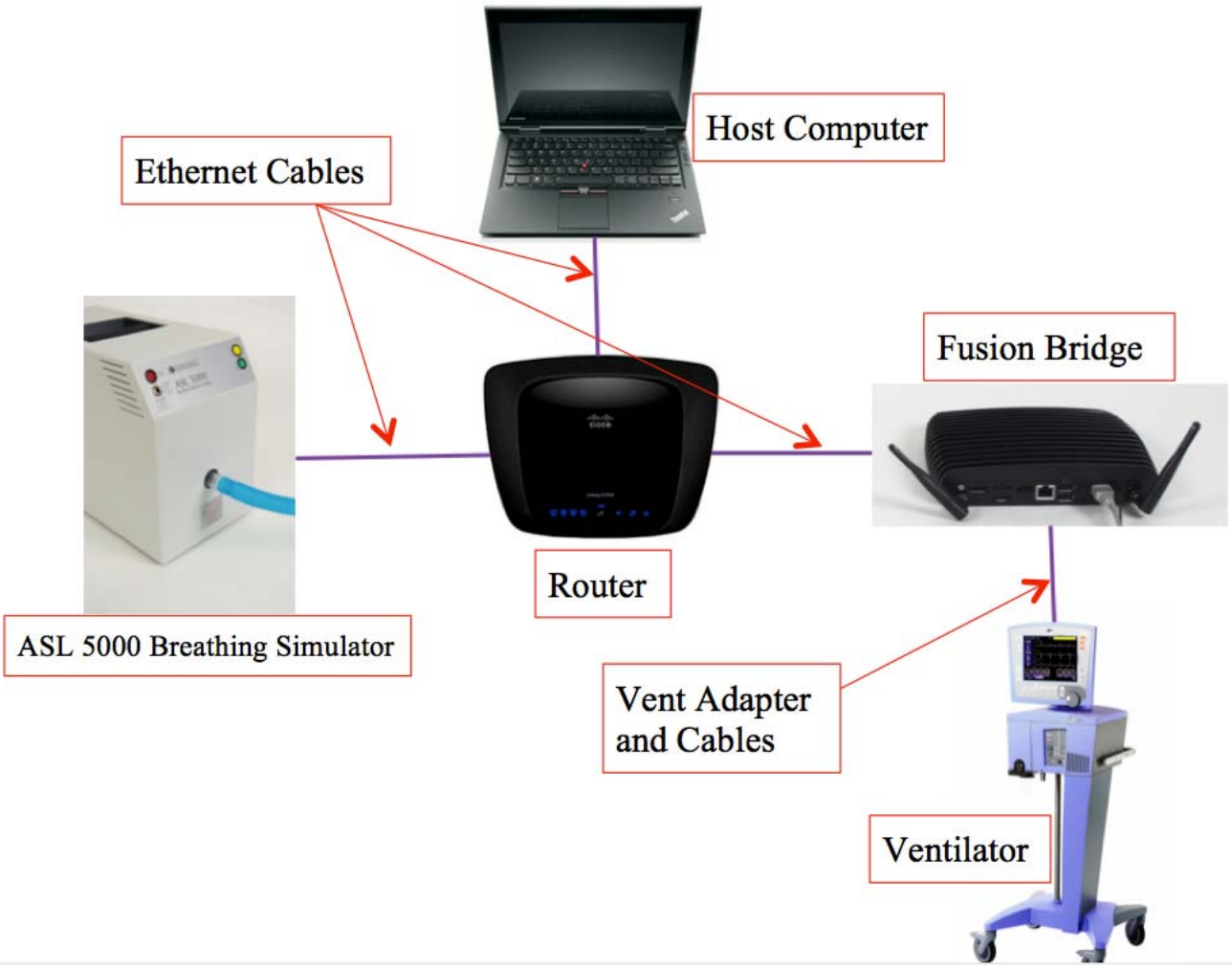


Figure 5-3 RespiSim Ventilator Interface Kit Setup

5.4 Launching the VIK Software

With all components plugged in:

1) Turn ventilator on and connect to a passive test lung (e.g. IngMar Medical QuickLung), either directly, or via the SBLVM ("Simulator Bypass and Leak Valve Module", see ASL 5000 User's Manual).
2) Start the AutoScan application by double-clicking the icon on the desktop.
   —After connecting to the database, AutoScan should now start performing scans showing data collected from the ventilator in the data field.
   —In the AutoScan application, click on **File**, then **Configure**. Make sure the settings are as follows when using a pre-configured Fusion Bridge.

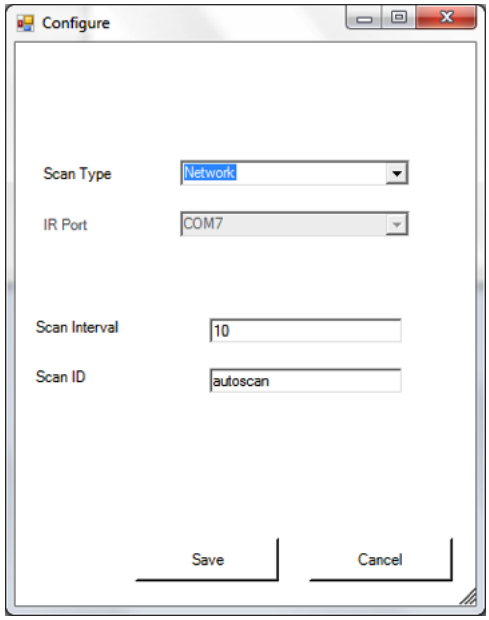


Figure 5-4 Communication Configuration

   —With the above settings, the database will update the ventilator information to the AutoScan application as well as to the RespiSim window in the ASL 5000 software every 10 seconds.

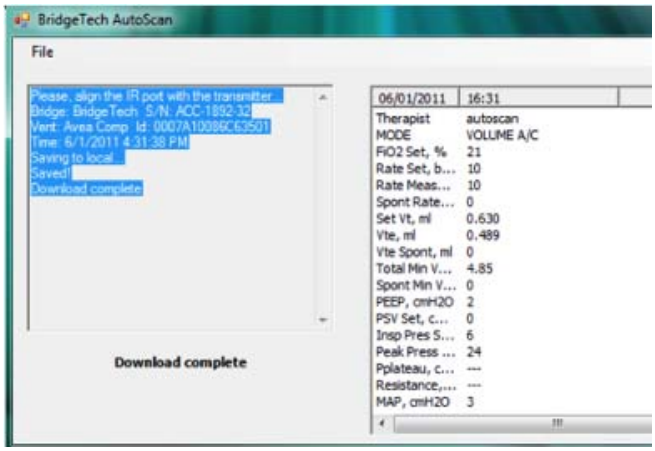


Figure 5-5 BridgeTech AutoScan Data View

NOTE: Not all ventilators are capable of updating the data output at the rate of 10 seconds. Therefore, data from the ventilator should not be considered fully real-time.