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Edition History

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Use of supplies or accessories other than those recommended by Philips may compromise product performance.

THIS PRODUCT IS NOT INTENDED FOR HOME USE. U.S. FEDERAL LAW restricts this device to sale BY OR ON THE ORDER OF A PHYSICIAN.
This User Training Workbook should be used primarily for HeartStart XL+ instructor-based end-user training, along with the 453564091541 Instructor Guide. The workbook contains the following conventions:

**“Voice”** represents voice prompt messages

**Text** represents messages that appear on the display

**Text** represents bolded directions to the instructor that appear in the guide and options that appear on HeartStart XL+ menus

**[Soft key]** represents soft key labels that appear on the display above the button to which they correspond.
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Getting Acquainted

Lesson Introduction

This lesson provides an overview of the HeartStart XL+ controls, indicators, operational modes, and display views. It also provides general information on use of the device.

Objectives

Upon completion of this lesson, you should be able to:
1. Identify the physical features, controls, and indicators of the XL+.
2. Identify the purpose of various controls and indicators.
3. Identify the display view characteristics associated with XL+’s operating modes.
4. Identify the correct procedure for responding to an alarm.

Time

10-20 minutes

Accessories Recommended

- ECG simulator
- Hands-free cable
- Multifunction electrode pads
- 3- or 5-Lead monitoring ECG
- Optional SpO₂ and NBP parameter accessories

Notes:

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
Lesson Presentation

Overview

- The HeartStart XL+ is designed to meet the advanced requirements of hospital code teams, nurses, physicians, and biomedical engineers. It has controls, indicators, and menus organized to facilitate ease of use.

Basic Orientation

Front Panel

The front of the device contains operational controls and indicators, as shown in Figure 1.

Figure 1  Front View
**Therapy knob**
Serves as the XL+ power switch and can be set to:
- **AED** - to enable AED Mode for semi-automated external defibrillation
- **Off**
- **Monitor** - to enable Monitor Mode for 3- or 5-Lead ECG monitoring, or optional SpO₂ and NBP monitoring
- **Manual Defibrillation** - to enable Manual Mode for asynchronous or synchronous defibrillation (cardioversion) at the selected energy setting
- **Pacer** (optional) - to enable Pacer Mode for demand or fixed mode pacing

**General Function Buttons**
Control monitoring or non-critical resuscitation activities
- **Lead Select** - changes the ECG lead in Wave Sector 1; cycles through the available ECG waves, changing the displayed wave and label
- **Patient Category** - allows you to quickly change the patient category from adult (≥ 25kg or ≥ 8 years old) to infant/child (<25kg or < 8 years old)
- **Menu Select** - displays the current menu or confirms a menu selection
- **Navigation** - displays the current menu; moves to the next or previous item in a list; increases or decreases numbers or values in a sequence; may be held down to accelerate through the available choices.
- **Print** - initiates a continuous print-out of the primary ECG and the other selected waveforms either real-time or with a 10-second delay
- **Reports** - displays a menu from which you can print an Event Summary report or Trends Report
- **Mark Event** - inserts a time-stamped annotation in the Event Summary Report to note events as they occur
- **Alarms** - pauses all audible physiological and technical alarms for the configured time interval
- **Charge button** - charges the defibrillator to the selected Manual Defibrillation energy setting. Used only in Manual Mode. Defibrillator charges automatically in AED Mode.
- **Shock button** - delivers a shock through multifunction electrode pads or switchless internal paddles. The button flashes when charged. Also, deliver a shock through external paddles when the Shock buttons on the paddles flash
- **Sync button** - toggles between asynchronous and synchronous (cardioversion) defibrillation. Lights blue when Sync is active

**Soft Keys**
Perform functions presented as labels appearing immediately above the keys on the display. Labels (and related functions) change based on the mode of operation.
Indicators

Provide a visual display of device status

Ready For Use (RFU)

<table>
<thead>
<tr>
<th>Blinking Hourglass</th>
<th>Indicates the shock, pacing and ECG functions of the device are ready for use. Sufficient battery power is available for device operation.</th>
</tr>
</thead>
</table>
| Blinking red “X” with periodic audio chirp | Indicates either:  
- A low battery condition exists and the battery is not charging.  
- There is no battery installed and the device is running on AC power only. |
| Blinking red “X” without periodic audio chirp | Indicates a low battery power condition but the battery is currently charging. The device can be used but its battery-only operation time is limited. |
| Solid red “X” with periodic audio chirp | Indicates a critical failure has been detected that may prevent the delivery of defibrillation therapy, pacing or ECG acquisition. |
| Solid red “X” without periodic audio chirp | Indicates no power available or the device cannot power on. If, after power is returned, the indicator reverts to the blinking black hourglass symbol, the device is ready for use. |

External Power

- A green AC Power Indicator indicates AC power is connected to the HeartStart XL+, even if the device is turned off.
- A green Battery Charging Indicator flashes when the battery is charging. The indicator is solid green when the battery is fully charged and AC power is present.

The front panel also includes the printer door and latch, speaker (for audible alarms and AED voice prompts), and the display.

Notes:
Side Panels

- The left panel is dedicated to monitoring ECG, SpO₂ and NBP (see Figure 2).

**Figure 2  Left (Monitor) Side View**

- The right side of the HeartStart XL+ is dedicated to administering therapy. It contains a therapy port for paddles (external or internal) or for a therapy cable with multifunction electrode pads, as shown in Figure 3.

**Figure 3  Right (Therapy) Side View**
Top Panel

The top panel has a handle (that includes the RFU indicator) and a USB data port that lets you export data to a USB drive and import configurations and new software revisions from the drive. Optional external (adult/infant) paddles also reside here, as shown in Figure 4.

**Figure 4  Top View (with optional paddles installed)**
Back Panel

The back panel has a Lithium Ion battery compartment, an AC power connection, an ECG Out jack to connect to an external monitor, and a LAN port. See Figure 5.

Figure 5  Back Side View

Lithium Ion Battery

- Has a fuel gauge with 5 LED indicators, each representing a charge of approximately 20% of capacity. Press the fuel gauge button to illuminate the fuel gauge.

Figure 6  Battery Gauge

Notes:

________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
________________________________________________________________________________
Display View

Display Layout

The XL+ display has four basic areas. See Figure 7.

**Figure 7 General Display Layout**

- **Status Area**
  - Date and time
  - Patient information
    - Event timer
    - Paced status
    - Name
    - Patient category and weight range
  - Device information
    - Battery status
    - Clinical alarm indicator
    - Technical alarms

- **Parameter Area**
  Information for each parameter includes:
  - Parameter label
  - Possible current value
  - Units label
  - Current upper and lower alarm limits
Message Area
Displays key messages during an event, according to the current operating mode (See sample in Figure 8)

Figure 8 Message Area

Waveform and Display Soft Keys Area
- Displays up to three wave sectors are available with a preconfigured waveform in Monitor, Manual Defibrillation, Pacing Mode (two wave sectors only), and AED (one wave sector).
- Displays the number of shocks delivered and the selected energy
- Wave Sector 1 markings shown below

Figure 9 Wave Sector 1 Markings

- Wave Sectors 2 & 3 automatically populate when the parameter source's cable is connected to the HeartStart XL+
- Four soft key labels correspond to soft key buttons

Menus

Figure 10 Sample Menu
Alarms

Table 1  Alarm Types

<table>
<thead>
<tr>
<th>Alarm Type</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Priority</td>
<td>An immediate response is required. A life-threatening alarm condition is present. A red alarm message is displayed and an alarm tone sounds.</td>
</tr>
<tr>
<td>Example: VFIB/VTACH</td>
<td></td>
</tr>
<tr>
<td>Medium Priority</td>
<td>Prompt response is required. A non-life-threatening alarm condition exists. A yellow alarm message is displayed and an alarm tone sounds.</td>
</tr>
<tr>
<td>Example: SPO2 LOW</td>
<td></td>
</tr>
<tr>
<td>Low Priority</td>
<td>Awareness is required. A non-life-threatening alarm condition exists. A cyan alarm message is displayed and an alarm tone sounds.</td>
</tr>
<tr>
<td>Example: Print Door Open</td>
<td></td>
</tr>
<tr>
<td>Latching</td>
<td>The alarm remains active regardless if the alarm condition continues to exist or not. A latching alarm is not removed until it is either acknowledged or a higher priority alarm condition occurs.</td>
</tr>
<tr>
<td>Non-Latching</td>
<td>The HeartStart XL+ automatically removes the alarm when the alarm condition no longer exists.</td>
</tr>
</tbody>
</table>

Table 2  Alarm Notification Types

<table>
<thead>
<tr>
<th>Notification</th>
<th>Indication on Display</th>
<th>Indication Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarms On</td>
<td>None</td>
<td>Both visual and audio indications are on.</td>
</tr>
<tr>
<td>Alarm Audio</td>
<td>Audio Pause</td>
<td>Only visual indications are on for the duration of the Audio Pause timeframe, which is configurable. When the pause timeframe is complete, both audio and visual indications are on.</td>
</tr>
<tr>
<td>Pause</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarm Audio</td>
<td>Audio Off</td>
<td>Only visual indications are on.</td>
</tr>
<tr>
<td>Off</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alarms Off</td>
<td>Alarms Off</td>
<td>Both audio and visual indications are off for a set period of time.</td>
</tr>
</tbody>
</table>

Responding to Alarms

Follow the steps below to respond to an alarm condition.

1. Attend to the patient.
2. Identify the alarm(s) indicated.
3. Silence (pause) the alarm(s) using the Menu Select button or pressing the Alarms button.
4. Address the alarm condition (Acknowledge, New Limits, or Alarms Off).
Entering Patient Information

To enter patient information:

1. Press the Menu Select button to activate the Main Menu.
3. Select the category you want to enter information for and press Menu Select.
4. When entering the patient's name, the Last Name screen appears with a menu of letters to enter the last name. Using the Navigation buttons, select the first letter of the patient's last name.
   a. Press the Menu Select button to select the letter.
   b. Repeat the process with the remaining letters of the last name.
   c. Once you have completed spelling the last name, select Done.
5. Repeat Step 4 to insert the patient's first name. You are prompted to enter a Patient ID.
6. If entering the Patient ID, the Patient ID screen appears with a menu of letters and numbers to enter the ID.
7. If entering the patient's sex, the sex menu appears with Male and Female options to select.
8. If entering the patient's internal paced status, the Paced Menu appears with Yes and No options. Select Yes if the patient is paced and No if they are not paced.

Continued Use

Facilitates continued treatment of the same patient by retaining current settings and the patient record when the XL+ is turned off for less than 10 seconds or switching between modes (e.g., from Monitor to AED).
Installing the Cable Wraps

To attach the cable wraps to the device:
1. Snap the cable wrap into the Cable Management Connector snap on the back of the device.
2. Loop your cable around the cable wrap and snap into place.
3. To remove the cable, tug on the loose end of the cable wrap to unsnap.

Figure 11 Cable Wrap
Filling the Accessory Pouches

- **Monitor side**
  - Connect the NBP tubing to the NBP port. Coil the remaining tubing with the NBP cuff. Place them in the outside slot of the double-sided black bag.
  - Connect the SpO₂ cable to the SpO₂ port. Coil the remaining cable and finger sensor and place them in the inside slot of the double-sided bag.
  - Connect the ECG cable to the ECG port. Coil the remaining cable and leads and place it in the large pouch.

- **Therapy side**
  - Connect the Therapy Cable to the Therapy port. Coil the remaining cable and place it in the large pouch.
  - If you are using the Pads Cable, place pads in the inside slot of the double-sided bag. If you use paddles, place gel pads or conductive material in the inside slot.

**Figure 12 Monitor Side Accessories  Figure 13 Therapy Side Accessories**
Installing Paper

To install the paper:
1. Open the printer door by pushing on the printer door latch.
2. Pull up on the empty or almost empty roll to remove it.
3. Examine the new roll and remove any remaining adhesive residue from the outer layer of paper.
4. Place the new roll in the paper well such that the end of the roll is on the bottom and the grid faces up.
5. Pull the end of the paper out past the roller.
6. Close the printer door.
7. Test the printer before putting the device back into service.

Test Plug

Figure 14 Installing Printer Paper

Figure 15 Connecting Defibrillator Test Plug
Review

Please answer the following questions related to XL+ features, controls, and display view.

1. Identify at least three controls or buttons on the XL+ involved with defibrillation.
   a. ________________________________________
   b. ________________________________________
   c. ________________________________________

2. What does a solid red “X” and periodic audio chirp indicate on the RFU?
   a. No battery is present (blinking red “X” and chirp)
   b. No power is available (solid red “X” and no chirp)
   c. A low battery condition (blinking red “X” and chirp)
   d. Defibrillation therapy may not be available

3. The arrhythmia algorithm uses the ECG in which Wave Sector for analysis?
   a. 1
   b. 2
   c. 3
   d. all of the above

4. True or false? You can select the ECG lead for Wave Sector 2 using the Lead Select button.

5. True or false? Silencing audio indications of active alarms can result in missed alarm conditions and inhibit indications of new alarm conditions.
Lesson Introduction

This lesson describes the basic ECG monitoring functions of the HeartStart XL+.

Objectives

Upon completion of this lesson, you should be able to:
1. Locate pertinent information in Monitor View.
2. Prepare a patient for ECG monitoring.
3. Set heart rate and arrhythmia alarms.
4. Display an annotated ECG.
5. Initiate manual relearning.

Time

10-20 minutes

Accessories Recommended

- ECG simulator
- Hands-free cable
- Multifunction electrode pads
- 3- or 5-Lead monitoring electrodes
Lesson Presentation

Overview

- Monitor Mode monitors adult and infant/child ECGs using multifunction electrode pads or 3- or 5-Lead ECG sets. External paddles can be used for quick assessment only.
- The XL+ uses the ST/AR Basic Arrhythmia Algorithm for arrhythmia analysis.

Preparation

Follow the procedures below to prepare for monitoring using multifunction electrode pads or electrodes.

Multifunction electrode pads

1. If not pre-connected, insert the pads cable into the green Therapy port.
2. Connect the pads to the pads cable.
3. Prepare the patient’s skin.
4. Apply multifunction electrode pads to the patient according to the pads package directions or your organization’s protocol.

Electrodes

1. Prepare the patient’s skin at the appropriate electrode sites.
2. Attach the snaps to the electrodes.
3. Apply the electrodes.
4. If not pre-connected, connect the ECG patient cable.
Monitor View

Monitor View is displayed when you turn the Therapy knob to Monitor. You can view three waves simultaneously while monitoring all current vital sign parameters. See Figure 7.

Selecting the Waveform

Use the Lead Select button to select the ECG wave for Wave Sector 1. To select a waveform for Wave Sectors 2 and 3:

1. Press the Menu Select button.
2. Select Displayed Waves and press Menu Select.
3. Select the appropriate wave sector and press Menu Select.
4. Select the desired wave type and press Menu Select.
5. If needed, select the appropriate ECG wave size and press Menu Select.
Practice Exercise 1

Attach a simulator and 5-Lead ECG set to the XL+, set the simulator to a normal sinus rhythm, and complete a variety of lead selections for Wave Sectors 2 and 3, as appropriate. Try adding a SpO2 sensor cable to see how a wave sector is affected.

Questions
1. How do Wave 2 and/or 3 menus differ from each other in terms of available leads? From Wave 1 menu?
2. What wave size(s) provide the clearest wave form?
3. How does the display change when you add a parameter?

Notes:

________________________________________________________________________
________________________________________________________________________
________________________________________________________________________

Displaying an Annotated ECG

Beat labels appear in Wave Sector 2 based on the ST/AR Algorithm analysis.

Table 3 Arrhythmia Beat Labels

<table>
<thead>
<tr>
<th>Label</th>
<th>Description</th>
<th>Where Displayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>Normal</td>
<td>Above QRS</td>
</tr>
<tr>
<td>V</td>
<td>Ventricular ectopic</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>Paced</td>
<td></td>
</tr>
<tr>
<td>L</td>
<td>Learning patient’s ECG</td>
<td></td>
</tr>
<tr>
<td>?</td>
<td>Insufficient information to classify beats</td>
<td></td>
</tr>
<tr>
<td>‘</td>
<td>Pacer spike</td>
<td>Above waveform, where pacer spike was detected (If the patient is both atrially and ventricularly paced, the display shows two marks above the waveform aligned with the atrial and ventricular pacing.)</td>
</tr>
<tr>
<td>“</td>
<td>Biventricular pace pulse</td>
<td>Above waveform where the biventricular pace pulse was detected</td>
</tr>
<tr>
<td>A</td>
<td>Artifact (noisy episode)</td>
<td>Above waveform where noise was detected</td>
</tr>
<tr>
<td>I</td>
<td>Inoperative condition (e.g. there is a lead off)</td>
<td>Above waveform; at start of a technical alarm, every second of the alarm and at the end</td>
</tr>
<tr>
<td>M</td>
<td>Pause, Missed beat, No QRS</td>
<td>Above waveform where condition detected</td>
</tr>
</tbody>
</table>
To display an annotated ECG:
1. Press Menu Select.
2. Select Displayed Waves and press Menu Select.
4. Select Annotated ECG and press Menu Select.

**Practice Exercise 2**
Display an annotated ECG.

**Question**
1. Where does the annotation first appear?

**Arrhythmia Learning/Relearning**
- The HeartStart XL+ automatically performs arrhythmia learning/relearning:
  - when the Therapy knob is turned to Monitor, Pacer, AED or a selected energy.
  - when there is a change in the lead selection for Wave Sector 1.
  - after the correction of a lead or pads off condition that has been active longer than 60 seconds.
- To initiate relearning manually:
  1. Press Menu Select.
  2. Select Measurements/Alarms and press Menu Select.
  3. Select HR/Arrhythmia and press Menu Select.
  4. Select Relearn Rhythm and press Menu Select.

**Practice Exercise 3**
Complete the steps to initiate manual relearning.

**Notes:**
________________________________________________________________
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________________________________________________________________
________________________________________________________________
Heart Rate and Arrhythmia Alarms

Introduction

The HeartStart XL+ detects heart rate and arrhythmia alarm conditions by comparing ECG data to a set of pre-defined criteria. The following tables (4 and 5) outline characteristics of the various HR and arrhythmia alarms and the figures (8 and 9) depict related alarm chains.

Table 4  HR/Arrhythmia Physiological Alarms

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Condition</th>
<th>Type of Alarm</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asystole</td>
<td>No detectable beats for four seconds in the absence of V-Fib.</td>
<td>High Priority Latching Alarm</td>
<td>Red Alarm message with alarm tone</td>
</tr>
<tr>
<td>VFib/VTach</td>
<td>A fibrillatory wave detected for four seconds.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VTach</td>
<td>Consecutive PVCs and HR exceed configured limits.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme Brady</td>
<td>Extreme Brady - 10 bpm below HR low limit, capped at 30 bpm.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Extreme Tachy</td>
<td>Extreme Tachy - 20 bpm above HR High limit, capped at 200 bpm (adult)/240 bpm (infant/child).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacer Not Capture</td>
<td>No QRS following internal pacer pulse.</td>
<td>Medium Priority Latching Alarm</td>
<td>Yellow Alarm message with alarm tone</td>
</tr>
<tr>
<td>Pacer Not Pace</td>
<td>No QRS or pacer internal pulse detected.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PVC xx &gt; limit/min</td>
<td>The number of detected PVCs in a minute exceed the limit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HR High</td>
<td>The HR exceeds the configured HR High limit.</td>
<td>Medium Priority Non-Latching Alarm</td>
<td></td>
</tr>
<tr>
<td>HR Low</td>
<td>The HR is below the configured HR Low limit.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 5  HR/Arrhythmia Technical Alarms

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Condition</th>
<th>Type of Alarm</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lead/ Pads/ Paddles Off</td>
<td>The multifunction electrode pad/paddles or leads used as the source for Wave Sector 1 during Synchronized Cardioversion may be disconnected or not attached securely.</td>
<td>High Priority Non-Latching Alarm</td>
<td>Red Alarm message with alarm tone</td>
</tr>
<tr>
<td>Cannot Analyze ECG</td>
<td>ECG data in Wave Sector 1 cannot be analyzed – an electrode used is disconnected/not attached securely.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The analyzing algorithm cannot analyze the ECG signal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ECG Equipment Malfunction</td>
<td>A malfunction has occurred in the ECG hardware.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pads ECG Equipment Malfunction</td>
<td>A malfunction has occurred in the Pads ECG hardware.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Disabled: Therapy</td>
<td>Therapy is disabled due to an equipment failure.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 17  Basic Mode Arrhythmia Alarm Priority Chain

For Monitor, Manual Defibrillation, Synchronized Cardioversion and Pacing

RED ALARMS (High Priority)

Asystole
  ↓
V-Fib/VTach
  ↓
VTach
  ↓
Extreme Tachy
  ↓
Extreme Brady

YELLOW ARRHYTHMIA ALARMS (Medium Priority)

PVC Alarms
  ↓
PVCs > x/Min.
  ↓
Beat Detection Alarms
  ↓
Pacer Not Capture
  ↓
Rate Alarms
  ↓
Pacer Not Pacing
  ↓
High/Low HR
Figure 18 Cardiotach Mode Arrhythmia Alarm Priority Chain

For AED Mode Only
RED ALARMS (High Priority)
  Asystole
  V-Fib/VTach

Extreme Tachy
Extreme Brady

YELLOW ARRHYTHMIA ALARMS (Medium Priority)

High/Low HR

Practice Exercise 4
Set the simulator and XL+ to produce a variety of latching and non-latching conditions, as directed.

Questions
1. What do you see and hear when a red alarm goes off? A yellow alarm?
2. If you acknowledge the Alarm Pause message in response to an alarm, will you be alerted if the patient's condition persists or recurs?

Notes:
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Setting Alarms
- Heart rate, VTACH, and PVC Rate Limit alarm settings for the current patient may be changed during an event.
- Other HR and arrhythmia alarms may not be changed.
Changing Alarm Limits

To change HR, VTACH, or PVC Rate limits:
1. Press the Menu Select button.
2. Select Measurements/Alarms and press Menu Select.
3. Select HR/Arrhythmia and press Menu Select.
4. Select HR Limits (or VTACH Limits or PVC Rate Limits) and press Menu Select.
5. Select new values and press Menu Select.

Enabling/Disabling Alarms

To enable or disable HR and arrhythmia alarms:
1. Press Menu Select.
2. Select Measurements/Alarms and press Menu Select.
3. Select HR/Arrhythmia and press Menu Select.
4. Select Alarms On (Alarms Off) and press Menu Select.

Note: Disabling alarms prevent all alarms associated with HR measurements from being annunciated. If an alarm condition occurs, no alarm indication will be given.

Responding to HR and Arrhythmia Alarms

The Menu Select or Navigation buttons silence alarm audio.
To respond to an alarm
1. Acknowledge the alarm condition.
2. Adjust the limits using the New Limits menu.

Practice Exercise 5

Change HR, VTACH, or PVC Rate limits, and enable/disable and respond to alarms.

Questions
What happens when you change a limit? Disable an alarm?

Notes:

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Review

Please answer the following questions related to ECG and arrhythmia monitoring.

1. Identify the Monitoring View elements.

2. You can select the ECG wave for Wave Sectors 1-3 using the Lead Select button. True / False

3. You can show an annotated ECG with beat labels appear in Wave Sector 2. True / False

4. The XL+ automatically performs arrhythmia learning/relearning when there is a lead selection change for Wave Sector 1 or 2. True / False

5. Which of the following statement(s) are TRUE?
   
   a. All arrhythmia alarms are classified as “latching” alarms.
   
   b. HR and arrhythmia technical alarms are classified as high priority alarms.
   
   c. Any HR and arrhythmia alarm settings can be changed during an event.
   
   d. Menu Select AND Navigation buttons can acknowledge alarms.
Semi-Automated External Defibrillation

Lesson Introduction

This lesson describes how to use AED Mode.

Objectives

Upon completion of this lesson, students should be able to:

1. Locate pertinent information in AED View.
2. Prepare a patient for AED defibrillation.
3. Defibrillate in AED Mode.

Time

10-15 minutes

Accessories Recommended

- ECG simulator
- Hands-free cable
- Multifunction electrode pads
Lesson Presentation

Overview

- AED Mode guides you through standard treatment algorithms for cardiac arrest.
- It includes voice and screen prompts for defibrillation preparation, ECG analysis, and shock delivery.
- The HeartStart XL+ uses Philips' SMART Analysis algorithm to make a shock decision in AED Mode.
- AED Mode can be used on both adult and infant/child patients.

AED View

Turn the Therapy knob to AED to display the AED View.

Figure 20 AED View Layout

Notes:

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Preparation

To prepare for AED:
1. Confirm the patient’s condition (i.e., unresponsive, not breathing, and/or pulseless).
2. Prepare the patient’s chest.
3. Check the multifunction electrode pads package expiration date and for damage.
4. If not pre-connected, connect the pads cable into the green Therapy port.
5. If the pads are not expired and package is undamaged, connect the pads to the pads cable.
6. Apply multifunction electrode pads to the patient as directed on the pads package or according to your organization’s protocol.

AED Mode

To defibrillate in AED Mode:
1. Turn the Therapy knob to AED.
2. Follow the screen and voice prompts.
3. No one should be touching the patient or anything connected to patient. Call out clearly and loudly “Stay Clear!” Press the orange Shock button, if prompted.

Practice Exercise 1

Turn the Therapy knob to AED without a pads cable and/or pads connected to see what prompts are generated.

Notes:

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Shock Advised

Practice Exercise 2

Attach the pads cable and a simulator to the XL+, set the simulator to a shockable rhythm (e.g., VF), and complete defibrillation (with one shock).

Questions
1. What screen prompts do you see and voice prompts do you hear initially?
2. How do you know the device is ready to deliver a charge?
3. What do you see and hear after delivering a shock?
4. What happens when you press the [Resume Analyzing] soft key?

Notes:

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No Shock Advised

Practice Exercise 3
Set the simulator to NSR.

Questions
1. What screen prompts do you see and voice prompts do you hear?
2. What happens when you press the [CPR] soft key?

Notes:

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Using AED Mode to Monitor
To monitor ECG in AED Mode and activate alarms:
1. Turn the Therapy knob to AED.
2. After performing an initial ECG rhythm analysis, if the rhythm is not shockable, the HeartStart XL+ begins to monitor the patient.
3. To activate ECG alarms in AED Mode, press the Alarms button on the front of the HeartStart XL+.

To monitor optional SpO₂ and pulse in AED Mode and activate alarms:
1. Once in AED Mode, attach an SpO₂ sensor to the patient.
2. If you have the device configured to monitor SpO₂ in AED Mode, SpO₂ monitoring begins once a pulsatile reading is obtained.
3. To activate SpO₂ and pulse alarms in AED Mode, press the Alarms button on the front of the HeartStart XL+. 
Review

Please answer the following questions related to AED Mode.

1. Identify the AED View elements.

Figure 21  AED View Layout

2. Apply multifunction electrode pads for AED according to pads package directions or your organization's protocol. True / False

3. What are the three basic steps for AED using the XL+?
   a. _________________________________
   b. _________________________________
   c. _________________________________

4. Which of the following statement(s) about AED Mode are TRUE?
   a. The XL+ automatically checks for proper pads cable and pads connection.
   b. If artifact interferes with ECG analysis and persists, analysis will suspend but resume automatically after 60 seconds.
   c. The XL+ automatically disarms if a shock becomes unnecessary.
   d. The XL+ automatically prompts to begin CPR after a shock is delivered.
Manual Defibrillation and Cardioversion

Lesson Introduction

This lesson explains how to prepare for and perform manual asynchronous and synchronous (cardioversion) defibrillation using multifunction electrode pads and external/internal paddles.

Objectives

Upon completion of this lesson, you should be able to:
1. Locate pertinent information in Code View.
2. Prepare a patient for asynchronous and synchronous defibrillation.
3. Perform asynchronous and synchronous defibrillation.

Time

10-20 minutes

Accessories Recommended

- ECG simulator
- Hands-free cable
- Multifunction electrode pads
- External paddles
- Internal paddles (include M4740A Paddle Adapter Cable for switchless paddles)
- 3- or 5-Lead monitoring electrodes
Lesson Presentation

Manual Mode

- The entire defibrillation process is under your control (i.e., you assess the ECG, decide if defibrillation or cardioversion is indicated, select the appropriate energy setting, charge the device, and deliver the shock).
- Text messages are present; voice prompts are not present.

Code View

Connect a simulator to the XL+, set it to a normal sinus rhythm (NSR), and turn the Therapy knob to the 150J setting.

Figure 22 Code View Layout

Notes:

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Manual Defibrillation Preparation

Follow the steps below to prepare for manual defibrillation using multifunction electrode pads, external paddles, and/or internal paddles.

Multifunction electrode pads

1. Confirm the patient’s condition (i.e., unresponsive, not breathing, and/or pulseless).
2. Prepare the patient’s chest. Wipe moisture away and, if necessary, clip or shave excessive chest hair.
3. Check the multifunction electrode pads package expiration date and for damage.
4. If not pre-connected, connect the pads cable into the green Therapy port.
5. If the pads are not expired and package is undamaged, connect the pads to the pads cable.
6. Apply multifunction electrode pads to the patient as directed on the pads package or according to your organization’s protocol.

External paddles

1. Confirm the patient’s condition (i.e., unresponsive, not breathing, and/or pulseless).
2. If not pre-connected, insert the paddles cable into the green Therapy port.
3. Remove the paddles from the paddle tray. Verify there is no debris or residue (including dried electrode gel) on the paddle surfaces. Clean if necessary.
4. Apply conductive matter as per your organization’s protocol.
5. Apply the paddles to the patient’s bare chest, using the anterior-anterior placement or your organization’s protocol.
6. Use the Patient Contact Indicator (PCI) lights on the sternum paddle handle to adjust paddle pressure and placement to optimize patient contact. Once proper contact is made, the PCI turns green.

Quick Look

To view a patient’s ECG using external paddles:

1. Make sure the device is turned on to Monitor.
2. Apply external paddles to the patient’s chest, minimizing any unnecessary movement.
3. After the HeartStart XL+ detects the ECG, view the waveform on the display.

Internal paddles

1. Select the appropriate switched or switchless paddle electrode size.
2. If using switchless paddles, connect the paddles to the M4740A Paddle Adapter Cable.
3. Connect the paddles cable (or the paddle adapter cable) to the XL+.
Manual Defibrillation

To complete manual defibrillation:
1. Turn the Therapy knob to the desired energy setting.
2. Press the Charge button on the XL+ (or external paddle).
3. Make sure no one is touching patient or anything connected to patient before shock; call out loudly and clearly “Stay Clear”.
4. Press the orange Shock button on the XL+ (for pads and switchless internal paddles) or the button(s) on both external paddles or switched internal paddle.

Practice Exercise 1

Attach a simulator and parameter accessories (if appropriate) to the XL+, set the simulator to a shockable rhythm (e.g., VF), and complete manual defibrillation (with 1 shock). Try changing the energy level during and/or after a charge.

Questions
1. What do you see and hear during a charge?
2. How do you know the device is ready to deliver a shock?
3. What do you see and hear after delivering a shock?
4. How do you know if alarms are active?
5. What happens when you press the [Cancel Charge] soft key?

Notes:
Synchronized Cardioversion

- Deliver a biphasic pulse of current to the heart immediately following an R-wave detected in the ECG waveform through either multifunction electrode pads or external paddles.
- Monitor ECG through 3- or 5-Lead monitoring electrodes when using external paddles.

Preparation

Follow the steps below to prepare for synchronized cardioversion.

1. Perform the tasks as described in the previous Manual Defibrillation Preparation topic.
2. If monitoring through a 3- or 5-Lead ECG cable, plug the cable into XL+’s ECG port, and apply monitoring electrodes to the patient.
3. Use the Lead Select button to select pads, paddles, or a lead from attached monitoring electrodes for Wave Sector 1.

Notes:
Synchronized Shock Delivery

To deliver a synchronized shock:

1. Turn the Therapy knob to the desired energy setting and press the Sync button.

2. Confirm that the Sync button lights up, the Sync indicator is present on the XL+ display, and R-Wave arrows appears only with each R-wave. If arrows do not appear, select another lead.

3. Press the Charge button on the XL+ (or external paddle).

4. Make sure no one is touching the patient or anything connected to the patient before delivering a shock; call out loudly and clearly “Stay Clear”.

5. Check your ECG and then re-confirm your energy dose and waveform. Press and hold the Shock button on the XL+ (or orange buttons on both paddles). The shock will be delivered when the next R-wave is detected.

Practice Exercise 2

Attach a simulator and pads to the XL+, set the simulator to an abnormal rhythm (e.g., AFIB), and complete synchronized cardioversion.

Questions

1. What do you see on the display when you press the Sync button?

2. How do you know if sync is active?

3. How long do you need to press the Shock button?

4. Once in Sync mode, what happens when you turn the Therapy knob to a position other than a selected energy?

5. What happens when you press the Sync button a second time?

Notes:

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Review

Answer the following questions related to manual defibrillation and synchronized cardioversion.

1. Identify the Code View elements in manual defibrillation.

2. What are the three basic steps for manual defibrillation using the XL+?
   a. _________________________________________________
   b. _________________________________________________
   c. _________________________________________________

3. The XL+ is ready to deliver a shock via pads when the XL+ sounds a continuous high-pitched tone, the charged value on the display matches the Therapy knob setting, and the Shock button flashes. True / False

4. What are the four basic steps for synchronized cardioversion using the XL+?
   a. _________________________________________________
   b. _________________________________________________
   c. _________________________________________________
   d. _________________________________________________
Noninvasive Pacing

Lesson Introduction

This lesson describes the noninvasive transcutaneous pacing option available with the HeartStart XL+ and how to perform pacing.

Objectives

Upon completion of this lesson, you should be able to:
1. Identify pertinent information in Pacing View.
2. Prepare a patient for pacing.
3. Perform demand or fixed mode pacing.

Time

10-20 minutes

Accessories Recommended

- ECG simulator
- Hands-free cable
- Multifunction electrode pads
- 3- or 5-Lead monitoring electrodes
Lesson Presentation

Pacer Mode

- Pacer Mode delivers monophasic pace pulses to the heart through multifunction electrode pads.
- Waveforms, ECG monitoring, measurements, and most alarms remain active and retain their settings when transitioning from Monitor or Manual Defibrillation Mode to Pacer Mode; however, the waveform in Wave Sector 3 is replaced by the pacing status bar.
- Pacing Mode can be used on both adult and infant/child patients.

Pacing View

Turn the Therapy knob to **Pacer** to display the Pacing View.

**Figure 23 Pacing View Layout**

![Pacing View Layout](image)

Pacing Control soft key: Press **[Pause Pacing]** to pause pacing; press **[Start Pacing]** to start or resume pacing.

Notes:

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________________________________________________________________
________________________________________________________________
________________________________________________________________

42
Demand vs. Fixed Mode

Demand mode
- Synchronous pace pulses are delivered when the patient’s heart rate is lower than the selected pacing rate.
- Use this mode whenever possible.
- XL+ requires a 3- or 5-Lead ECG cable and monitoring electrodes as the ECG source while pace pulses are delivered through multifunction electrode pads; however, the pads cannot be used to monitor ECG and deliver paced pulses simultaneously.

Fixed mode
- Asynchronous pace pulses are delivered at the selected rate.
- Use when motion artifact or other ECG noise makes R-wave detection unreliable, when monitoring electrodes are not available, or at your clinical discretion.

Notes:
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Preparation

Follow the steps below to prepare for pacing.
1. If not pre-connected, connect the pads cable to the green Therapy port on the XL+.
2. Prepare the patient’s skin for good contact for the monitoring electrodes and multifunction electrode pads.
3. Apply multifunction electrode pads to the patient as directed on the pads packaging or according to your organization’s protocol.
4. Connect the pads connector to the pads cable.
5. If pacing in demand mode, apply monitoring electrodes and connect the ECG cable to the ECG port on the XL+.
Demand Mode Pacing

To pace in demand mode:

1. Turn the Therapy knob to the Pacer position.
2. Press the Lead Select button to select the best lead with an easily detectable R-wave.
3. Verify white R-wave arrows appear above or on the ECG waveform, with a single arrow for each R-wave. If no R-wave arrows appear, are incorrectly labeling beats, or do not coincide with the R-wave, select another lead.
4. Press the [Rate] soft key and use the upper portion of the soft key to increase the rate and the lower portion of the soft key to decrease the rate.
5. If needed, adjust the initial pacer output before you start pacing. Press the [Output] soft key and use the upper portion of the soft key to increase the output and the lower portion of the soft key to decrease the output.
6. Press the [Start Pacing] soft key. The message Pacing appears in the pacing bar.
7. Verify white pacing markers or white R-wave arrows appear on the ECG waveform.
   a. Use the upper portion of the soft key to increase the output until cardiac capture occurs.
   b. Use the lower portion of the soft key to decrease the output to the lowest level that still maintains capture.
9. Assess the patient for a peripheral pulse.

To stop delivery of pace pulses, press the [Pause Pacing] soft key. Using the Navigation buttons, select Yes to pause pacing; select No to continue pacing. Once paused, press the flashing [Start Pacing] soft key to resume pacing. Also stop pacing by moving the Therapy knob off the Pacer position.

Practice Exercise 1

Attach pads and electrodes to the XL+ and a simulator, set the simulator to bradycardia, and complete demand mode pacing.

Questions

1. What display changes do you see when completing each step (i.e., turn on pacing, set pacing status, adjust pacer rate and output, and stop pacing)?
2. How do you know when pace pulses are being delivered?
Fixed Mode Pacing

To pace in fixed mode:

1. Turn the Therapy knob to Pacer.
2. Change the pacer mode to Fixed, using the Pacer Mode menu off the Main Menu.
3. Press the Lead Select button to select the desired lead for viewing, if one is available.

Note: The remaining steps are similar to demand mode pacing.

4. Select the pacer rate by pressing the [Rate] soft key. Use the upper portion of the soft key to increase the rate and the lower portion of the soft key to decrease the rate.
5. If needed, adjust the initial pacer output. Press the [Output] soft key. Use the upper portion of the soft key to increase the output and the lower portion of the soft key to decrease the output.
7. If you have an ECG waveform, verify white pacing markers appear.
8. Verify the presence of a peripheral pulse and increase output if required.
   a. Use the upper portion of the soft key to increase the output until cardiac capture occurs.
   b. Use the lower portion of the soft key to decrease the output to the lowest level that still maintains capture.
10. Assess the patient for a peripheral pulse.

To pause or stop pacing:
   - Press [Pause Pacing] or
   - Move the Therapy knob off the Pacer position.

Practice Exercise 2

Attach pads and electrodes to the XL+ and a simulator, set the simulator to bradycardia or a sinus rhythm with a HR of 40, and complete fixed mode pacing.

Questions

1. What display changes do you see when completing each step (i.e., turn on pacing, set pacing status, adjust pacer rate and output, and stop pacing)?
2. How do you know when pace pulses are being delivered?

Notes:
Pacing Alarms

Pacing alarms can be generated for the conditions shown in the following table.

Table 6  Pacing Alarms

<table>
<thead>
<tr>
<th>Alarm Message</th>
<th>Condition</th>
<th>Type of Alarm</th>
<th>Indication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacing Stopped. Power Interrupted.</td>
<td>Pacing has stopped. There has been a power failure during pacing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacing Stopped. Pads Off.</td>
<td>Pacing has stopped. A pads off condition has been detected during pacing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacing Stopped. Device Error.</td>
<td>Pacing has stopped. The HeartStart XL+ has detected an error which prevents delivery of pacing therapy.</td>
<td>High Priority Non-Latching Alarm</td>
<td>Red Alarm message with alarm tone</td>
</tr>
<tr>
<td>Pacing Stopped. Pads Cable Off.</td>
<td>Pacing has stopped. The pads cable is disconnected from the device.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equipment Disabled: Therapy</td>
<td>Therapy is disabled due to an equipment failure.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacing Stopped. Leads Off.</td>
<td>Pacing has stopped. The primary ECG lead has become invalid in Demand Mode pacing.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacer Output Low</td>
<td>The actual delivered pace pulse current is less than the selected output.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Battery Low</td>
<td>The battery's charge level is low.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Review

Please answer the following questions related to pacing.

1. Which of the following statement(s) are TRUE related to pacing with the XL+?
   a. The device requires a 3- or 5-Lead ECG cable and monitoring electrodes during demand mode pacing.
   b. The device always delivers pace pulses in demand mode.
   c. The Pacing status bar indicates pacing mode, status, rate, and output.
   d. If you exit Pacer Mode to defibrillate and then return to Pacer Mode, the settings from the previous pacing session must be re-entered.

2. Which ONE of the following steps should be performed before pacing is initiated in demand mode?
   a. Verify that a white pacing marker appears in front of each QRS complex.
   b. Verify that white R-wave arrows appear above or on the ECG waveform.
   c. Increase pacer output until cardiac capture occurs.
   d. Decrease pacer output to the lowest level that still maintains capture.
Pulse Oximetry Monitoring

Lesson Introduction

This lesson describes how to use the HeartStart XL+ to monitor Pulse Oximetry (SpO₂).

Objectives

Upon completion of this lesson, you should be able to:
1. Monitor SpO₂.
2. Set SpO₂ and pulse rate alarms.

Time

10-15 minutes

Accessories Recommended

• SpO₂ sensor
Lesson Presentation

Monitoring SpO₂

To monitor SpO₂:
1. Connect the appropriate sensor cable to the XL+.
2. Apply the sensor to the patient.
3. Turn the Therapy knob to a clinical mode.
4. Check that the patient category is appropriate for the patient and change, if necessary.

- A -?- displays in the Parameter Area while oxygen saturation is initially measured and an SpO₂ value is calculated; a value replaces -?- and is updated continuously as the patient’s oxygen saturation changes.
- The patient’s pulse rate (derived from pulse oximetry) is also displayed in Parameter Area.
- The pleth wave is displayed in the configured Wave Sector between grid lines to indicate signal quality.

Notes:
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SpO₂ Alarms

Changing Alarm Limits

To change the SpO₂ alarm limits:
1. Press the Menu Select button.
2. Using the Navigation buttons, select the Measurements/Alarms menu and press Menu Select.
4. Select SpO₂ Limits and press Menu Select.
5. Using the Navigation buttons, select the new high limit value and press Menu Select.
6. Select the new low limit value and press Menu Select.
Enabling/Disabling Alarms

To enable the SpO2 alarms:
1. Press the Menu Select button.
2. Using the Navigation buttons, select the Measurements/Alarms menu and press Menu Select.
4. Select Alarms On (Alarms Off) and press Menu Select.

Practice Exercise 1

Change SpO2 limits, and enable/disable and respond to related alarms.

Questions
1. What happens when you change a limit? Disable an alarm? Respond to an alarm?

Notes:

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Pulse Rate Alarms

Changing Pulse Rate Alarm Limits

To change pulse rate alarm limits:
1. Press the Menu Select button.
2. Using the Navigation buttons, select the Measurements/Alarms menu and press Menu Select.
4. Select Pulse Limits and press Menu Select.
5. Using the Navigation buttons, select the new high limit value and press Menu Select.
6. Select the new low limit value and press Menu Select.
**Enabling/Disabling Pulse Rate Alarms**

To enable pulse rate alarms:

1. Press the Menu Select button.
2. Using the Navigation buttons, select the **Measurements/Alarms** menu and press Menu Select.
3. Select **Pulse** and press Menu Select.

**Practice Exercise 2**

Change pulse rate limits, and enable/disable and respond to related alarms.

**Questions**

1. What happens when you change a limit? Disable an alarm? Respond to an alarm?

**Disabling the SpO₂ Monitoring Function**

To disable the SpO₂ monitoring:

Disconnect the sensor cable from the SpO₂ port. The message **SpO₂ Unplugged. Turn off SpO₂?** appears. Select **Yes** and press the Menu Select button.

Should the sensor cable be disconnected accidentally, the message **SpO₂ Unplugged. Turn off SpO₂?** appears. Select **No** and press Menu Select. Then, secure the connection to begin monitoring again.

**Notes:**

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Review

Answer the following questions related to SpO2 monitoring.

1. You can monitor SpO2 in all XL+ modes (Monitor, Manual Defibrillation, AED or Pacer). True / False
2. The pleth wave is auto scaled to grid lines when the signal quality is poor. True / False
3. SpO2 alarms are off unless turned on during use while pulse rate alarms are on unless turned off during use. True / False
Noninvasive Blood Pressure Monitoring

Lesson Introduction

This lesson describes how to monitor noninvasive blood pressure (NBP) with the HeartStart XL+.

Objectives

Upon completion of this lesson, you should be able to:
1. Monitor NBP.
2. Set NBP alarms.

Time

10-15 minutes

Accessories Recommended

• NBP cuff
Lesson Presentation

Overview

- NBP may be measured in Monitor, Pacer, or Manual Defibrillation (including Synchronized Cardioversion) Modes.
- NBP measurements can be taken automatically on a pre-set schedule or manually on demand.
- Systolic, diastolic, and mean pressure, measurement schedule (manual or automatic intervals), and a time stamp are displayed in the Parameter Area.

Notes:

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Measuring NBP

To measure NBP:
1. Select the appropriately sized cuff for the patient.
2. Attach the cuff to the NBP tubing, making sure that air can pass through the tubing and the tubing is not squeezed or kinked.
3. Insert the NBP tubing into the NBP port on the XL+.
4. Apply the blood pressure cuff to the patient’s arm or leg.
5. Place the limb used for taking the measurement at the same level as the patient’s heart.
6. Press the [Start NBP] soft key. NBP values display when the measurement is complete.
Press the [Stop NBP] soft key to stop an NBP reading.

NBP Schedule

To change the NBP schedule:
1. Press the Menu Select button.
2. Using the Navigation buttons, select the Measurements/Alarms menu and press Menu Select.
5. Using the Navigation buttons, select the desired interval and press Menu Select.
Practice Exercise 1

Complete manual and automatic NBP measurements, including changing the NBP schedule.

Questions
1. What displays when you start a measurement? Stop a measurement?
2. How does the display differ between a manual and automatic measurement?

Notes:
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NBP Alarms

Changing NBP Alarm and Source Limits
To change the NBP alarm source and/or limits:
1. Press the Menu Select button.
2. Using the Navigation buttons, select the Measurements/Alarms menu and press Menu Select.
4. Select NBP Limits and press Menu Select.
5. Select the desired source for the alarm (Systolic, Diastolic, or Mean) and press Menu Select.
6. Using the Navigation buttons, increase or decrease the high limit value and press Menu Select.
7. Set the new low limit value and press Menu Select.

Enabling/Disabling NBP Alarms
To enable/disable NBP alarms:
1. Press the Menu Select button.
4. Select Alarms On (Alarms Off) and press Menu Select.
Practice Exercise 2

Change NBP alarm limits, and enable/disable and respond to related alarms.

Questions

1. What happens when you change a limit? Disable an alarm? Respond to an alarm?

Notes:

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Review

Please answer the following questions related to monitoring NBP.

1. Which of the following items can display when monitoring NBP?
   a. Systolic and diastolic pressure
   b. Alarm limits
   c. Automatic measurement schedule
   d. Time stamp

2. You can take manual measurements during an automatic measurement schedule. True / False

3. NBP alarms are enabled unless disabled. True / False
Trending

Lesson Introduction

This lesson describes the HeartStart XL+ Trending and related report data.

Objectives

Upon completion of this lesson, you should be able to:

1. Identify data and functionality of the Trending Report.

Time

5-10 minutes

Accessories Recommended

- ECG simulator
- Option monitoring cables to produce trending data (i.e., SpO₂ and/or NBP)
Lesson Presentation

Overview

- View and print numeric vital sign trending for the current incident in Monitor Mode.
- Heart rate, SpO2, and pulse data are the average of multiple measurements over the trend time period. NBP data appear with the timestamp of the measurement.

Viewing Trending Data

To view trending data:
1. Turn the Therapy Knob to Monitor.
2. Press the Menu Select button.

Trending Report Intervals

To adjust the interval:
1. With Trending active on your display, press the Menu Select button.
3. Using the Navigation buttons, select the trend interval you want and press Menu Select.

Navigating Around the Trending Report

- Use the horizontal scroll soft keys to scroll left and right in the Trending Report. A soft key is inactive (grayed out) if there is no more data to be viewed in that direction.
- If there are more lines of data than can be shown on the screen, use the Navigation buttons above the Menu soft key to scroll up and down the report.
Printing the Trending Report

To print the Trending Report:
1. Press the Report button.
2. Using the Navigation buttons, select **Trends** and then the appropriate interval.
Trends Reports can also be printed from Data Management Mode.

Closing the Trending Report

To close the Trending Report and return to a waveform display, simply press the **[Close Trends]** soft key.

Practice Exercise 1

Change report time intervals, scroll through data, and print out sample reports.

Questions
1. Does the layout of a report change in any way when you increase or decrease the time interval?
2. Does the information on a printout differ from what you see on the display?

Notes:

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Review

Please answer the following questions related to the Trending Report.

1. Data from continuous measurements is the average of multiple measurements over the trend time period. True / False

2. Which of the following statement(s) are TRUE regarding data displayed on the Trending Report?
   a. If you scroll left to view older data, the screen will update the newest new data when you scroll right.
   b. Questionable data is indicated by -?.
   c. Unavailable data is indicated by an empty space.
   d. Multiple measurements taken during an interval in indicated by a ^ after the timestamp.
Lesson Introduction

This lesson describes the data management features of the HeartStart XL+.

Objectives

Upon completion of this lesson, you should be able to:

1. Identify XL+ data management features.
2. Identify characteristics associated with printing data.
3. Mark patient events.

Time

5-15 minutes

Accessories Recommended

- USB drive
Lesson Presentation

Overview

- The HeartStart XL+ automatically generates an Event Summary for each patient event. Each Event Summary is assigned a unique event identification number, is date/time stamped and stored in the device's internal memory.
- Data is available for viewing, reporting, and printing, or copied to a USB flash drive for transfer to a data management application.
- A new Event Summary is initiated the first time one of the following occurs after the device is powered on:
  - The arrival of a valid ECG signal either through electrodes or pads/paddles
  - The arrival of valid SpO\textsubscript{2} data
  - The arrival of valid NBP data
  - The Charge button is pressed
  - The Mark Event button is pressed
- Event Summary data collected, if available, includes:
  - Two ECG waveforms with beat labels
  - One pleth waveform
  - Patient event information
  - Technical/device event information
  - Research data

Notes:

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**Data Management Mode**

Data Management Mode is a non-clinical mode used to manage event data records.

To enter Data Management Mode:

1. Turn the Therapy knob to either Monitor, Pacer or Manual Defibrillation.
2. Press the Menu Select button.
5. Confirm your selection. Use the Navigation buttons to select Yes and press Menu Select. If you select No, you are returned to the mode you started from.

**Internal Memory Menu**

To use the Data Management - Internal Memory menu:

1. Confirm you are in Data Management Mode.
2. Press the Menu Select button.
3. Using the Navigation buttons, select your desired operation. You can:
   a. **Print** the currently selected Event Summary.
   b. **Export** the currently selected Event Summary to the USB drive.
   c. **Export All** Event Summaries currently in Internal Memory to the USB drive.
   d. **Remove All Patient Info** to de-identify all Event Summaries in Internal Memory.
   e. **View USB Drive** to view all Event Summaries on an external USB drive.
   f. **Exit** the menu.
4. Press Menu Select to perform the task.

**Accessing Data on the USB Drive**

**Saving Data to the USB Drive**

To save data to a USB drive from Data Management Mode, Configuration Mode, and after an Operational Check:

1. Confirm a USB drive is inserted into the USB port.
2. Press the [Export] soft key or press the Menu Select button and select Export from the menu. The HeartStart XL+ copies your data to the USB drive.

**Deleting Event Summaries from the USB Drive**

To delete Event Summaries from the USB drive:

1. Confirm you are in Data Management Mode.
2. Press the Menu Select button.
4. Once in the USB Drive screen, press Menu Select.
5. The USB Drive menu appears.
6. Using the Navigation buttons, select **Erase Drive**.

7. Press Menu Select to erase all event summaries from the USB drive.

8. HeartStart XL+ prompts you to confirm your selection. Select **Yes** to erase all data on the drive. Select **No** to leave all data on the drive.

**Printing Data**

**Printing During a Patient Event**

To print a strip during an event:

1. Press the Print button.

To print an Event Summary for the current event:

1. Press the Reports button.


**Printing While in Data Management Mode**

To print an Event Summary contained in Internal Memory:

1. Select the Event Summary you wish to print.

2. Press the Menu Select button and select **Print**.

   OR

   Press the Reports button, select **Event Summary** from the listing, and press Menu Select to print.

To print a Trends Report related to an Event Summary contained in Internal Memory:

1. Select the Event Summary that contains the Trends Report you wish to print.

2. Press the Reports button, select **Trends** from the listing, and press Menu Select.

3. Using the Navigation buttons, select the Trend Interval you want. Press the Menu Select button to begin printing.

**Notes:**

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Marking Events

To annotate the Event Summary and the ECG strip with an event:

1. Press the Mark Event button. The Events menu is displayed.
2. Using the Navigation buttons, select the desired event.
3. Press the Menu Select button to mark the event. If configured, an ECG strip prints, including the mark event symbol and the selected event label.
Review

Please answer the following questions related to XL+ data management.

1. Which of the following statement(s) are TRUE related to XL+’s data management?
   a. Data management includes Event Summaries that have a unique event identification number and are automatically stored in internal memory.
   b. New Event Summaries are initiated by the arrival of valid SpO2 or NBP data, along with other activities.
   c. The number of Event Summaries stored in memory is related to the USB drive space available.
   d. You should not enter Data Management Mode when monitoring a patient.

2. You can only save Event Summaries to and delete from the USB drive. True / False

3. The XL+ can print information in BOTH clinical and non-clinical modes. True / False

4. If configured, the Mark Event button prints a 5-second ECG strip leading up to the marked event, the event itself, and the 5 seconds after the event. True / False
Lesson Introduction

This lesson describes how to care for the HeartStart XL+, including a brief look at battery maintenance and cleaning.

Objectives

Upon completion of this lesson, you should be able to:
1. Identify the meaning of automated test summary results.
2. Perform the necessary steps to complete an operational check on the XL+.
3. Identify the appropriate steps related to battery maintenance.
4. Identify the appropriate steps to clean the XL+ and its associated accessories.

Time

10-20 minutes

Accessories Recommended

- ECG simulator (or test plug)
- Hands-free cable (or Pads cable, when appropriate)
- Multifunction electrode pads or external paddles
- 3- or 5-Lead monitoring electrodes cable
Lesson Presentation

Automated Tests

The following automated tests assess XL+ operational performance and alert users if a problem exists.

<table>
<thead>
<tr>
<th>Test Name</th>
<th>Description</th>
<th>Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hourly</td>
<td>Tests power supply, charge level of the battery, internal communication across all critical modules and components and also the device's internal temperature.</td>
<td>Every hour</td>
</tr>
<tr>
<td>Daily</td>
<td>Tests all hourly components as well as defibrillation, ECG, pacing, SpO₂, NBP and the printer.</td>
<td>Daily after midnight according to the device's internal clock</td>
</tr>
<tr>
<td>Weekly</td>
<td>Tests all daily components as well as various electrical circuit tests and administers a 150J shock internally to test the defibrillation circuitry.</td>
<td>Weekly, after midnight Sunday morning according to the device's internal clock</td>
</tr>
</tbody>
</table>

- The following test results are reported through:
  - the Automated Test Summary report.
  - the RFU indicator.
  - statements on the XL+’s display when the device is turned on.

<table>
<thead>
<tr>
<th>RFU Indicator</th>
<th>Definition</th>
<th>Required Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pass</td>
<td>Hourglass</td>
<td>All tests passed.</td>
</tr>
<tr>
<td>Fail/DX</td>
<td>Solid red X, chirp</td>
<td>Service required. A critical device failure has been detected.</td>
</tr>
<tr>
<td>Fail/BW</td>
<td>Blinking red X</td>
<td>Service is not required but the battery is low or malfunctioning.</td>
</tr>
<tr>
<td>Fail/C</td>
<td>Hourglass</td>
<td>An ECG cable failure has been detected.</td>
</tr>
<tr>
<td>Fail/D</td>
<td>Hourglass</td>
<td>A non-critical failure has been detected.</td>
</tr>
</tbody>
</table>
Shift Check

The American Heart Association (AHA) recommends completion of a checklist (shift check) at the beginning of each change in personnel to ensure that defibrillators are ready when needed. You need to verify that the appropriate supplies and accessories are present, the device is plugged in and has sufficient battery power, and the device is ready for use.

Notes:

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Weekly Shock Test

In addition to the shift check, perform either a weekly shock test or an Operational Check once a week to verify the XL+’s ability to deliver defibrillation therapy. To perform a weekly shock test:

1. If using:
   - **External paddles:** Make sure the paddles and the paddle tray are thoroughly clean, there is no debris or residue (including all conductive material) on the electrode surfaces of the paddles and tray, the paddles are secure in their trays, and the Patient Contact Indicator (PCI) LEDs located on the sternum paddle are not lit. If the LEDs light, adjust the paddles in their pockets. If the LEDs continue to light, clean both the adult and infant paddle electrode surfaces.
   - **Multifunction electrode pads:** connect the defibrillator test plug (test load) to the end of the patient Therapy cable.

2. Turn the Therapy knob to 150J.

3. Press the Charge button. Follow the steps below for your particular set-up. If it is necessary to disarm the defibrillator, press the [Cancel Charge] soft key.

<table>
<thead>
<tr>
<th>If you are using pads with a test load:</th>
<th>If you are using pads with a defibrillator test plug:</th>
<th>If you are using paddles:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. A strip prints, if configured to do so. If the strip does not print immediately, press the Print button.</td>
<td>A strip prints, if configured to do so. If the strip does not print immediately, press the Print button.</td>
<td>A strip prints, if configured to do so. If the strip does not print immediately, press the Print button.</td>
</tr>
<tr>
<td>5. Press the Shock button on the HeartStart XL+ and deliver a shock into the test load.</td>
<td>Press the Shock button on the HeartStart XL+.</td>
<td>Simultaneously press the Shock buttons located on the paddles and deliver a shock into the paddle tray.</td>
</tr>
<tr>
<td>6. Confirm the printed strip indicates the defibrillator test passed and the energy delivered is 150J ± 15J (135J to 165J). If not, take the device out of use and call for service.</td>
<td>Confirm that you receive a <strong>Shock Aborted</strong> alarm and the printed strip indicates the defibrillator test passed. If not, take the device out of use and call for service.</td>
<td>Confirm the printed strip indicates the defibrillator test passed and the energy delivered is 150J ± 15J (135J to 165J). If not, take the device out of use and call for service.</td>
</tr>
<tr>
<td>7. Detach test load from the Therapy cable so your device is ready for use when needed. Do not leave the test load attached to the Therapy cable. If you use preconnected pads, reattach them. Test complete.</td>
<td>Detach defibrillator test plug from the Therapy cable so your device is ready for use when needed. Do not leave the test plug attached to the Therapy cable. If you use preconnected pads, reattach them. Test complete.</td>
<td>Test complete.</td>
</tr>
</tbody>
</table>
Operational Check

- The Operational Check verifies performance of a variety of device features, functionality, and accessories.

Performing the Operational Check

To prepare for the Operational Check:

- If you use external paddles - Make sure the paddles are connected to the device, paddles and the paddle tray are thoroughly clean and there is no debris or residue (including all conductive material) on the electrode surfaces of the paddles and tray. Secure the paddles in the tray and confirm the Patient Contact Indicator (PCI) LEDs are not lit. If the LEDs are lit, adjust the paddles in the tray. If the LEDs remain lit, clean both the adult and infant/child paddle electrode surfaces.

- If you use multifunction electrode pads - Make sure the pads therapy cable is plugged into the defibrillator test plug or test load.

To perform the Operational Check:

1. Confirm your device has a charged battery and an ECG cable connected (but not connected to a patient or lead sets).
2. Turn the Therapy knob to Monitor.
3. Press the Menu Select button.
5. Select Operational Check and press Menu Select.
7. Select Yes if you wish to continue with an Operational Check. Select No to return to Monitor Mode. Press Menu Select to confirm your choice.
8. If you selected Yes, the HeartStart XL+ displays the Operational Check Screen and starts the Operational Check automatically.
9. During the Operational Check, when a response is required, use the Navigation buttons to select your answer and the Menu Select button to confirm your choice. As each test runs, the name of the test appears highlighted on the display with the message In Progress.
10. After the automated part of Operational Check concludes, an Operational Check Report is printed if configured to do so.

Notes:
Battery Maintenance

Here are the battery maintenance activities and when they should be performed:

<table>
<thead>
<tr>
<th>Activity</th>
<th>When to Perform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perform a visual inspection.</td>
<td>As part of the Operational Check.</td>
</tr>
<tr>
<td>Charge the battery.</td>
<td>Upon receipt, after use, or if the message Low Battery is displayed.</td>
</tr>
<tr>
<td>Perform a calibration.</td>
<td>When the Operational Check test results state Calibration Required, or every 6 months, whichever comes first.</td>
</tr>
<tr>
<td>Store the battery.</td>
<td>When not in use for an extended period of time, store the battery at a 20-40% charge.</td>
</tr>
<tr>
<td>Discard the battery.</td>
<td>When there are visual signs of damage or you receive a message to replace the battery.</td>
</tr>
</tbody>
</table>

Notes:
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Cleaning Instructions

- The HeartStart XL+, along with its accessories and supplies, may not be autoclaved, steam cleaned, ultrasonically cleaned, or immersed unless otherwise indicated in the HeartStart XL+ Instructions for Use that accompany the accessories and supplies.
- Do not use abrasive cleaners or strong solvents such as acetone or acetone-based cleaners.
- Use a soft cloth to clean the display window to prevent scratching.
- Quaternary ammonium compounds such as Steris Coverage Plus NPD are not recommended for routine cleaning.
- Do not clean electrical contacts or connectors with bleach.
- Disinfect the device as determined by your organization's policy to avoid long-term damage to the device.

Defibrillator/Monitor, Paddles, Cables, and Battery

Hand wipe the exterior of the HeartStart XL+, external paddles, therapy cables, ECG cables and battery with a clean cloth. Remove all soil and wipe thoroughly with a water-dampened cloth before applying one of the following:
- Isopropyl alcohol (70% solution in water)
- Mild soap and water
• Chlorine bleach (containing 6% sodium hypochlorite), 3% solution in water
• Cleaning solutions/wipes with milder Isopropyl alcohol and chlorine bleach concentrations

**Printer Printhead**

To clean the printhead:

1. Push the printer door latch to open the door.
2. Remove the roll of paper.
3. Clean the printhead surface (top and front of compartment) with a cotton swab dipped in isopropyl alcohol.
4. Replace the roll of paper and close the door.

**Side Pouches**

After removing from the device, clean the side pouches by hand with mild soap and water and air dry.

**SpO\textsubscript{2} Sensor and Cable**

Follow the manufacturer’s instructions to clean the SpO\textsubscript{2} sensor and cable.

**NBP Cuff**

Follow the manufacturer’s instructions to clean the cuff.

**Notes:**

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Review

Please answer the following questions related the XL+ maintenance.

1. As a result of the automated test, a blinking red X on the RFU indicates a critical device failure and service is required. True / False

2. Which of the following statement(s) are TRUE related to the Operational Check?
   a. It checks therapy and ECG cables, charge and shock buttons, and the ability to deliver therapy.
   b. The ECG lead set should be connected to the ECG cable for the check.
   c. If you use multifunction electrode pads, the pads therapy cable should be plugged into the defibrillator test plug or test load.
   d. The Therapy knob must be set to 170J and then 150J, and then the check runs automatically.

3. Which of the following statement(s) are TRUE related to battery maintenance?
   a. Batteries should be inspected as part of the Operational Check.
   b. Discard the battery when there are visual signs of damage.
   c. Charge the battery in the XL+ connected to AC power.
   d. Frequency and duration of use have a direct correlation on battery life.

4. Which of the following statement(s) are TRUE related to XL+ and accessory cleaning?
   a. You can clean the exterior of the XL+ and the battery with chlorine bleach.
   b. You can clean the printer printhead surface with isopropyl alcohol.
   c. You should not steam sterilize any XL+ accessories.
   d. You can clean the side pouches by hand or machine with mild soap and water.
Review Answers

Getting Acquainted
1. Therapy knob, Charge button, Shock button, Sync button
2. d. Defibrillation therapy may not be available.
3. a. 1
4. False - You can only use the Lead Select button to select the ECG lead for Wave Sector 1.
5. True

ECG Monitoring
1. parameter area, message area, 3 wave sectors
2. False - The Lead Select button can only be used with Sector 1.
3. True
4. False - Automatic relearning takes place when there is a lead change for Wave Sector 1 only.
5. b. HR and arrhythmia technical alarms are classified as high priority alarms.; d. Menu Select AND Navigation buttons can acknowledge alarms.

Semi-Automated External Defibrillation
1. message area, enlarged Wave Sector 1, shock counter, energy setting, AED pause/CPR progress bar
2. True
3. a. Turn the Therapy Knob to AED.; b. Follow the voice and screen prompts.; c. Press the orange Shock button, if prompted.
4. a. The MRx automatically checks for proper pads cable and pads connection.; c. The MRx automatically disarms if a shock becomes unnecessary.; d. The XL+ automatically prompts to begin CPR after a shock is delivered.
**Manual Defibrillation and Cardioversion**

1. enlarged Wave Sector 1, shock counter, selected energy, Wave Sector 2

2. a. Turn the Therapy Knob to a desired energy level; b. Press the Charge button; c. Press the Shock button.

3. True

4. a. Turn the Therapy knob to the desired energy level and press the Sync button; b. Confirm that the Sync button lights up, the Sync indicator is present on the XL+ display, and R-Wave arrows appears only with each R-wave; c. Press the Charge button; d. Press and hold the Shock button(s).

**Noninvasive Pacing**

1. a. The device requires a 3- or 5-Lead ECG cable and monitoring electrodes during demand mode pacing; c. The Pacing status bar indicates pacing mode, status, rate, and output.

2. b. Verify that white R-wave arrows appear above or on the ECG waveform.

**Pulse Oximetry Monitoring**

1. True

2. False - The wave is auto scaled with a good signal.

3. False - SpO₂ alarms are on unless turned off during use while pulse rate alarms are off unless turned on.

**Noninvasive Blood Pressure Monitoring**

1. a. Systolic and diastolic pressure; b. Alarm limits; c. Automatic measurement schedule; d. Time stamp

2. True

3. True

**Trending**

1. True

2. a. If you scroll left to view older data, the screen will update the newest data when you scroll right; c. Unavailable data is indicated by an empty space. d. Multiple measurements taken during an interval is indicated by a ^ after the timestamp.
Data Management

1. a. Data management includes Event Summaries that have a unique event identification number and are automatically stored in internal memory.; b. New Event Summaries are initiated by valid SpO₂ or NBP data, along with other activities.; d. You should not enter Data Management Mode when monitoring a patient.

2. True

3. True

4. F - The Mark Event button can print a 10-second vs. 5-second ECG strip leading up to the marked event.

Maintenance

1. F - A solid red X and chirp indicates this result. The blinking red X indicates a low or malfunctioning battery and no required service.

2. a. It checks therapy and ECG cables, charge and shock buttons, and the ability to deliver therapy.; c. If you use multifunction electrode pads, the pads therapy cable should be plugged into the defibrillator test plug or test load.; d. The Therapy knob must be set to 170J and then 150J, and then the check runs automatically.

3. a. Batteries should be inspected as part of the Operational Check.; b. Discard the battery when there are visual signs of damage.; c. Charge the battery in the XL+ connected to AC power.; d. Frequency and duration of use have a direct correlation on battery life.

4. a. You can clean the exterior of the XL+ and the batteries with chlorine bleach.; b. You can clean the printer printhead surface with isopropyl alcohol.; You should not steam sterilize any XL+ accessories.