



CARDIAC ADVANCED RESUSCITATION EDUCATION

Instructor Guide

Scenario scripts for SimVAD — the LVAD training simulator. The iPad is the bedside console the learner reads; the iPhone is your instructor controller for triggering alarms and adjusting parameters.

RUNNING A SESSION

1. Open the console on the display the learner will read from — the **iPad** panel.
2. Keep the **iPhone** controller in your hand — it drives the console live and shows the same numbers back to you.
3. Start every session on **Normal Operation** so the learner sees baseline vitals before anything changes.
4. Tap a scenario on the iPhone to trigger it — the console updates instantly with new numbers, waveform, and (if applicable) an alarm banner and tone.
5. Use the **Console Findings** / **Likely Cause** / **Expected Actions** fields below to prompt the learner or answer questions in character as the bedside nurse.
6. Once the learner has identified and correctly responded to the problem, return to **Normal Operation** to clear the alarm, or use **Silence Alarm** on the controller to acknowledge it.
7. The gear icon on the iPad opens **Console Settings** — Pump Speed, Hematocrit, and the Low Flow Alarm threshold — for adjusting the case further live.
8. Close with the **Teaching Points** for each scenario as a structured debrief.

CONTENTS

SCENARIO LIBRARY

1 Normal Operation (Baseline)

2 Low Flow Alarm

3 Suction Event

4 Power / Battery Critical

5 Pump Thrombosis

6 Hypertension / High Afterload

7 RV Failure

8 Ventricular Arrhythmia

CHEAT SHEET — CONSOLE PARAMETERS

PUMP	Speed (RPM)	Fixed rotor speed set by the clinician. Normal range ~5000–5800 RPM; the console does not change this on its own.
PUMP	Flow (L/min)	Estimated pump output, derived from speed and power. Normal ~4–5.5 L/min; <2.5 L/min is a Low Flow Alarm.
PUMP	Power (Watts)	Energy the rotor draws to maintain speed. Rises with higher viscosity (polycythemia) or a developing thrombus; falls with anemia or low battery.
PUMP	Pulsatility Index (PI)	Amount of native heart contribution to flow. Normal ~3–5; a falling PI signals worsening filling, suction, or arrhythmia.
LABS	Hemoglobin / Hematocrit	Adjustable in Console Settings. Anemia thins blood (flow reads higher, power eases); polycythemia thickens it (flow drops, power rises).
HEMODYNAMICS	MAP	Mean arterial pressure. Low MAP suggests hypovolemia or right heart failure; high MAP (hypertension) raises afterload and drops flow.
HEMODYNAMICS	PAP	Pulmonary artery pressure (systolic/diastolic). Elevated PAP points to RV strain or pulmonary hypertension.
HEMODYNAMICS	CVP	Central venous pressure. Elevated CVP with low flow suggests RV failure; very low CVP suggests hypovolemia or a suction event.

CHEAT SHEET — CONTROLLER ACTIONS

Select Scenario	iPhone — instantly changes the console's live vitals, waveform, and alarm state.
Silence Alarm	iPhone — acknowledges/returns the scenario to Normal Operation.
Mute	iPad header — mutes the alarm tone without changing the scenario.
Pump Speed	iPad Console Settings — adjust RPM setpoint; flow and power respond accordingly.
Hematocrit	iPad Console Settings — adjust blood viscosity; changes flow/power via the anemia/polycythemia model.
Low Flow Alarm Threshold	iPad Console Settings — set the L/min value that triggers the Low Flow banner.

Normal Operation

J. Alvarez · Postop Day 12 · HeartMate-class LVAD, stable recovery

Steady State

SPEED	FLOW	POWER	PI	HR	MAP	PAP	CVP
5400 RPM	4.8 L/min	6.2 W	4.1	78	82	24/10	8

CONSOLE FINDINGS

All four tiles green/white, smooth rounded waveform, regular EKG, no banner, no tone.

INSTRUCTOR PROMPTS

Have the learner state each parameter and its normal range before moving to the next scenario.

TEACHING POINTS

Establish this baseline first every session — learners should be able to recognize normal before they can recognize abnormal. Point out that flow is pulsatile even on a fixed-speed pump, driven by the native heart, and that PI is the number that quantifies that pulsatility.

Low Flow Alarm

Same patient · outflow obstruction / hypovolemia stem

Alarm Triggered

SPEED	FLOW	POWER	PI	HR	MAP	PAP	CVP
5400 RPM	1.9 L/min	6.0 W	2.2	98	60	20/8	4

CONSOLE FINDINGS

Red banner "Low Flow Alarm — Assess Volume Status." Flow tile red, PI falling, low CVP.

LIKELY CAUSE

Hypovolemia or a kinked/obstructed outflow graft reducing preload to the pump.

EXPECTED ACTIONS

Assess volume status, consider a fluid bolus, examine the outflow graft/cannula position, recheck MAP.

RESOLUTION

Return to Normal Operation once the learner has verbalized the correct workup; discuss what a fluid challenge should look like on the console (flow and CVP should both rise).

TEACHING POINTS

Low flow with low CVP points to volume, not pump failure. Contrast this with Scenario 7 (RV Failure), where flow is also low but CVP is high — the same alarm, a very different cause and treatment.

Suction Event

Same patient · acute underfilling of the LV

Alarm Triggered

SPEED	FLOW	POWER	PI	HR	MAP	PAP	CVP
5400 RPM	2.4 L/min	5.6 W	1.1	104	70	18/7	3

CONSOLE FINDINGS

Red banner "Suction Event — Reduce Speed & Check Filling." PI drops sharply (near-flat waveform) — the hallmark suction finding.

LIKELY CAUSE

The inflow cannula is intermittently sucking against the septum or LV wall because the ventricle is underfilled at the current pump speed — from hypovolemia, tachyarrhythmia, or speed set too high for the patient's filling.

EXPECTED ACTIONS

Reduce pump speed first, then assess and correct volume status; check for arrhythmia contributing to poor filling.

RESOLUTION

Lower the Pump Speed setpoint in Console Settings and confirm PI and the waveform recover before returning to Normal Operation.

TEACHING POINTS

PI is the single best number for spotting suction — a flat or near-flat flow trace at a fixed speed almost always means the cannula is intermittently occluding. Speed reduction is the first action, before fluids.

Power / Battery Critical

Same patient · driveline/battery management stem

Alarm Triggered

SPEED	FLOW	POWER	PI	BATTERY	HR	MAP
5400 RPM	4.5 L/min	2.1 W	3.9	8%	80	80

CONSOLE FINDINGS

Amber banner "Battery Critical — Connect to AC Power." Battery reads 8%; flow/PI otherwise near-normal — this is an equipment alarm, not a physiologic one.

LIKELY CAUSE

Batteries not swapped/charged on schedule, or the patient has been off AC power longer than expected.

EXPECTED ACTIONS

Connect to AC power or swap batteries immediately, following the two-battery-minimum rule; do not disconnect both power sources at once.

RESOLUTION

Return to Normal Operation to simulate reconnection to power.

TEACHING POINTS

Not every alarm is hemodynamic — equipment/power management is a core competency and a common real-world cause of emergency calls. Drill the "always have a charged spare" habit.

Pump Thrombosis

Same patient · rising power, suspected clot

Alarm Triggered

SPEED	FLOW	POWER	PI	HR	MAP	PAP	CVP
5400 RPM	3.6 L/min	11.8 W	2.6	92	88	30/14	11

CONSOLE FINDINGS

Red banner "High Power — Suspect Pump Thrombosis / Hemolysis." Power tile roughly double baseline; the standout finding is power, not flow.

LIKELY CAUSE

A developing thrombus on the rotor increases the torque needed to maintain speed, driving power up; hemolysis markers (LDH, plasma-free hemoglobin) would be elevated clinically.

EXPECTED ACTIONS

Send LDH/plasma-free hemoglobin, review anticoagulation status, notify the VAD team/surgeon — this is a surgical emergency if confirmed.

RESOLUTION

Discuss escalation rather than a console fix — return to Normal Operation once management has been verbalized.

TEACHING POINTS

Power climbing without a matching rise in flow is the classic thrombosis signature. This is one of the few LVAD alarms that is a true surgical/hematologic emergency, not something to titrate at the bedside.

Hypertension / High Afterload

Same patient · uncontrolled blood pressure

Alarm Triggered

SPEED	FLOW	POWER	PI	HR	MAP	PAP	CVP
5400 RPM	3.2 L/min	7.4 W	2.4	78	108	26/12	9

CONSOLE FINDINGS

Amber banner "Reduced Flow — Check Blood Pressure (MAP)." MAP elevated to 108; flow and PI both down despite unchanged speed.

LIKELY CAUSE

Elevated afterload (uncontrolled hypertension) raises the pressure the pump must work against, reducing net forward flow at a fixed speed.

EXPECTED ACTIONS

Treat blood pressure per protocol (e.g. titrate an antihypertensive); avoid over-correcting speed as a substitute for BP control.

RESOLUTION

Return to Normal Operation once the learner identifies MAP — not the pump — as the primary problem.

TEACHING POINTS

LVAD patients are afterload-sensitive: uncontrolled hypertension is one of the most common reasons for a low-flow alarm with an otherwise unremarkable pump. Target MAP is typically <90 mmHg in most LVAD protocols.

RV Failure

Same patient · poor LV filling from right heart failure

Alarm Triggered

SPEED	FLOW	POWER	PI	HR	MAP	PAP	CVP
5400 RPM	2.6 L/min	5.4 W	1.5	106	66	40/22	19

CONSOLE FINDINGS

Red banner "Low Flow — Suspect RV Failure / Poor Filling." Low flow paired with a HIGH CVP (19) and elevated PAP (40/22) — the opposite CVP pattern from Scenario 2.

LIKELY CAUSE

The right ventricle cannot deliver enough blood to fill the LV for the pump to move, despite adequate or excess venous pressure — a common and serious LVAD complication.

EXPECTED ACTIONS

Avoid fluid boluses (CVP is already high); consider inotropic/pulmonary vasodilator support for the RV, and avoid increasing pump speed, which can worsen septal shift and RV function.

RESOLUTION

Return to Normal Operation once the learner distinguishes this from hypovolemic low flow using the CVP trend.

TEACHING POINTS

This is the key contrast case with Scenario 2: identical "low flow" alarm, opposite CVP finding, opposite treatment. Fluid given here would worsen RV failure. Reinforce reading CVP alongside flow before treating any low-flow alarm.

Ventricular Arrhythmia

Same patient · erratic native rhythm

Alarm Triggered

SPEED	FLOW	POWER	PI	HR	MAP	PAP	CVP
5400 RPM	3.4 L/min	6.1 W	1.8	128	74	24/11	10

CONSOLE FINDINGS

Amber banner "Erratic Pulsatility — Assess for Arrhythmia." The EKG and flow trace both show irregular spacing and beat strength — ectopic beats and a pause — rather than the usual even rhythm.

LIKELY CAUSE

A ventricular arrhythmia (e.g. runs of PVCs or non-sustained VT) is reducing the native heart's contribution to filling and flow, even though the pump keeps spinning at a fixed speed.

EXPECTED ACTIONS

Assess hemodynamic tolerance, obtain a rhythm strip/12-lead, treat the arrhythmia per protocol — LVAD patients can tolerate sustained VT/VF for a period since the pump continues to provide flow, but should still be treated promptly.

RESOLUTION

Return to Normal Operation once the learner correctly reads the irregular EKG/flow trace as arrhythmia rather than a pump malfunction.

TEACHING POINTS

A key LVAD-specific teaching point: unlike a native-heart patient, an LVAD patient in VT/VF may remain conscious and perfusing for a period because the pump keeps moving blood — don't anchor on "no pulse = no flow." Confirm with the console, not just the monitor.