

- I. **Title:** U/SS case 1
Massive Pulmonary Embolus with Pulseless Electrical Activity
(ACLS Cardiac Arrest)
- II. **Date Created:** July 12, 2005
Date Revised: December 8, 2006
- III. **Category:** Ultrasound Simulation; Teamwork / Resident Core Curriculum; ACLS
- IV. **Target Audience:** undergraduate and graduate medical trainees and staff,
nurses, paramedics
- V. **Learning Objectives or Assessment Objectives**
 - A. Primary -
 - a.) recognition and management of pulseless electrical activity (PEA)
 - b.) recognition and management of massive pulmonary embolism (PE) causing hemodynamic instability or collapse
 - c.) integration of Advanced Cardiac Life Support (ACLS) protocols into an organized medical resuscitation
 - d.) integration of bedside ultrasonography into an organized medical resuscitation
 - e.) deployment of teamwork behaviors
 - B. Secondary -
 - a.) appropriate airway management
 - b.) appropriate circulatory support
 - c.) appropriate use of thrombolytics and anticoagulant therapies
 - d.) appropriate consultation and disposition
 - C. Critical actions checklist (see Appendix A)-
 1. Simple checklist of critical actions
 - a.) recognition of unresponsiveness
 - b.) recognition of respiratory failure (apnea)
 - c.) recognition of circulatory failure (pulselessness)
 - d.) call for help and defibrillator
 - e.) establishment of team structure with role assignment
 - f.) deployment of appropriate communications and teamwork behaviors
 - g.) basic airway management (100% oxygen administration with bag-valve-mask ventilation)
 - h.) "quick-look" rhythm analysis (non-shockable rhythm recognition)
 - i.) basic circulatory management (CPR)
 - j.) advanced airway management (endotracheal intubation or laryngeal mask airway deployment, placement confirmation and securement, ventilator management)
 - k.) advanced circulatory support (cardiac monitor, vasoactive agents [epinephrine, vasopressors], peripheral + central venous access)

- l.) PEA recognition (i.e. continues CPR, does not defibrillate or cardiovert)
 - m.) PEA evaluation and management (reviews differential diagnosis, implementation of specific testing and treatment)
 - n.) recognition of massive PE as probable source of PEA
 - o.) recognition of progressive deterioration of PEA into recurrent pulseless ventricular tachycardia (VT)
 - p.) institution of thrombolytic therapy
 - q.) continued respiratory and circulatory support after thrombolytic administration
 - r.) supportive therapies upon improvement of circulatory function
 - s.) critical care medicine consultation
 - t.) disposition to critical care setting
2. Optimal sequence of critical actions- expected sequence as above
 3. Duration to critical actions- resuscitation to be completed within 30-35 minutes of starting scenario
 4. Behavioral ratings- see Appendix A

VI. ACGME Competencies Assessed

- A. Patient Care
- B. Medical Knowledge
- C. Interpersonal/Communication Skills

VII. Environment and Props

- A. Lab Set Up – Emergency Department in simulation center / lab
- B. Manikin Set Up –
 - a.) advanced medical simulation manikin
 - b.) female patient moulage with street clothing
 - c.) right short leg cast and splint
 - d.) lines needed: right arm 20g IV
 - e.) drugs needed: adrenergic agonists (epinephrine, norepinephrine infusion)
antiarrhythmic (lidocaine, amiodarone)
fibrinolytics (tPA, rPA, TNKase)
anticoagulants (heparin infusion)
- C. Props – see “USS CASE 1 IMAGES” folder
(basic airway and code blue cart is assumed)
 - a.) ECGs: sinus tachycardia 160-180s
 - b.) X-rays: normal chest X-ray
 - c.) special airway equipment (laryngeal mask airway [LMA])
 - d.) bedside echocardiogram images- right ventricular strain with fast, organized cardiac activity, no pericardial fluid
- D. Distractors –none

VIII. Simulation Personnel and Assigned Roles (Faculty, Actors, etc)

- A. Roles – paramedic x 1-2, nurse x 1, critical care medicine consultant
- B. Who may play them – other residents, other students, actors
- C. Action Role – supportive (see narrative)

IX. Case Narrative (describes what the learner will experience)

- A. Paragraph narrative overview of case and how case starts-

At 10pm, EMS brings in a 43 year old woman who stood up from bed, collapsed and had a brief seizure. Her husband performed CPR and called 911. The patient has been undergoing CPR for approximately 6 minutes at time of arrival in the Emergency Department.

- B. Board format overview of patient:

1. Name/Age/Sex: Lisa Roberts, 43 year old female
 2. Mode of arrival: EMS
 3. Accompanied by: husband (can be in waiting area until later)
 4. Triage Note: n/a
 5. Chief Complaint: [cardiac arrest]
 6. Past Medical History: **minor right foot surgery 2 weeks ago**
 7. Medications and Allergies: aspirin, vitamins, no known allergies
 8. Family and Social History: n/a
 9. Patient's Initial Exam:
 - Vital signs: heart rate: **no pulses without CPR**
blood pressure: **no pulses**
respiratory rate: **0**
oxygen saturation: **no waveform**
temperature: n/a
 - Airway: **no gag, pooled secretions**
 - Breathing: **no spontaneous respirations**
 - Circulation: **no pulses, warm extremities**
- Secondary Exam: middle-aged female, **CPR in progress**
- HEENT: **pooled secretions**
 - Neck: no JVP noted
 - Lungs: **no spontaneous breath sounds**
 - Cardiac: **no heart sounds**
 - Abdomen: no distention
 - Extremities: warm. **short-leg cast on right**
 - Neurologic: **GCS 3.** pupils 7mm

Additional information:

Fingerstick blood sugar: normal

EKG: **rapid narrow complex rhythm 160-180s**

CXR: normal

Bedside echocardiogram: right ventricular strain with fast, organized cardiac activity, no pericardial fluid

PCP: Dr. Jeff Cooper

- C. Flow diagram with branch points, times of expected interventions and reactions from Sim Man with notes (see Appendix A + B)

Case progression:

1. Despite “standard” PEA treatment (intravenous fluids, epinephrine, etc), progression to shockable pulseless rhythm (fast VT).
2. Defibrillation of fast VT results in transient return to sinus tachycardia 170-190s with blood pressure of 60 / 30 mmHg
3. Recurrent pulseless fast VT despite anti-arrhythmics
4. Intravenous thrombolytic administration and CPR for 10-15 minutes results in stable sinus tachycardia with gradual improvement

Optional: Inability to intubate -> LMA

- D. Distracters in case: n/a
- E. Trends needed: (see Appendix B)

X. Instructors Notes (what the instructor must do to create the experience)

- A. Tips to keep scenario flowing in lab and via computer
 - presentation of patient in extremis with persistently unstable rhythm without a definitive precipitant should keep the case moving quickly and with learner stress.
 - lulls in activity may be broken with entry of agitated spouse
- B. Tips to direct actors- as above
- C. Scenario programming- see Appendix B
 1. Optimal management path
 2. Potential complications path(s)
 3. Potential errors path(s)
 4. Program debugging

XI. Debriefing Plan

A. Method of debriefing

1. This is a simulation scenario faithful to a true PE / PEA patient who was resuscitated with excellent functional recovery. It may highlight the relevance of proper ACLS and aggressive critical interventions in Emergency Medicine

2. Debriefing Topics

a.) didactic content

- ACLS algorithms

- check responsiveness, pulselessness
- activate emergency response system
- early rhythm analysis

- airway management

- indications and technique of endotracheal intubation
- indications and technique of LMA use

- PEA

- assessment of “electrical” cardiac activity
- assessment of “mechanical” cardiac activity
- differential diagnosis (reversible causes)
 - hypovolemia
 - hypoxia
 - hydrogen ion
 - hyper- or hypo-kalemia
 - hypothermia
 - tablets
 - tamponade
 - tension PTX
 - thrombosis (coronary)
 - thrombosis (PE)
- use of epinephrine (not vasopressin)
- specific interventions
 - sodium bicarbonate
 - fluid bolus
 - needle decompression: bilateral
 - pericardiocentesis: use kit
 - thrombolytics
 - rewarming: target 92deg F
- continuing (prolonged) resuscitative efforts
 - hypothermia
 - PE

- emergency ultrasonography in PEA

- FAST
- cardiac and pericardial window
- pneumothorax views

- massive pulmonary embolism
 - presentation
 - identified or unknown risk factors for clot
 - may have profound hemodynamic instability
 - evaluation
 - role of bedside echocardiography to assess RV strain
 - CT angiogram
 - angiography
 - treatment
 - cardiac arrest
 - thrombolytic therapy with ACLS (may take up to 30 minutes for restored circulation)
 - consider bilateral thoracotomy with pulmonary vessel massaging to make clots peripheral as a temporizing measure
 - hemodynamic instability (present or impending)
 - thrombolytic therapy with ACLS
 - vasopressors (norepinephrine, isoproterenol)
 - anticoagulant therapy (heparin without bolus)
 - disposition
 - operating room for bypass
 - angiography for evaluation and intervention
 - critical care unit if unstable
 - telemetry unit if stable

b.) teamwork behaviors

- leadership
 - resuscitation leadership establishment
 - role and responsibility assignment
- collaboration
 - recognition and integration of team input
 - error recognition and correction
- communication
 - callouts of critical information
 - callbacks for confirmation of information
- situational awareness
 - continued patient reassessment
 - plan development and execution
 - task prioritization
 - workload assessment
 - team member cross-monitoring
 - requests for assistance
- professionalism

XII. Pilot Testing and Revisions

- A. Numbers of participants- 3-5 learners (1-2 leaders)
- B. Performance expectations, anticipated management mistakes
 - incorrect rhythm recognition
 - resistance to administration of thrombolytic therapy
 - premature termination of resuscitative efforts

XII. Authors and their affiliations

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X. Additional Debriefing Materials:

Goldhaber SZ, Nadel ES, King ME et al. Case 17-2004: A 42-year-old woman with cardiac arrest several weeks after an ankle fracture. *N Engl J Med* 2004; 350(22): 2281-90.

Janata K, Holzer M, Kurkciyan I et al. Major bleeding complications in cardiopulmonary resuscitation: the place of thrombolytic therapy in cardiac arrest due to massive pulmonary embolism. *Resuscitation* 2003; 57(1): 49-55.

Le Conte P, Huchet L, Trewick D. Efficacy of alteplase thrombolysis for ED treatment of pulmonary embolism with shock. *Am J Emerg Med* 2003; 21(5):438-40.

Leacche M, Unic D, Goldhaber SZ et al. Modern surgical treatment of massive pulmonary embolism: results in 47 consecutive patients after rapid diagnosis and aggressive surgical approach. *J Thorac Cardiovasc Surg* 2005; 129(5): 1018-23.

Levine M, Hirsh J, Weitz J et al. A randomized trial of a single bolus dosage regimen of recombinant tissue plasminogen activator in patients with acute pulmonary embolism. *Chest* 1990; 98(6): 1473-9.

Sharma, S. Pulmonary embolism. In eMedicine Specialties > Medicine, Ob/Gyn, Psychiatry, and Surgery > Pulmonology. Tino G, Talavera F, Anders GT et al. (eds), eMedicine Web site. Updated June 2, 2006. Available at: <http://www.emedicine.com/med/topic1958.htm> Accessed December 11, 2005.

Tang A, Euerle B. Emergency department ultrasound and echocardiography. *Emerg Med Clin North Am* 2005; 23(4): 1179-94.

Appendix A

Scenario Evaluation Form



Resident Name _____

Examiner _____

Case Title _____



Scenario Type Single Patient Multiple Patient

Critical Actions Checklist

	Critical Action	Yes	No	Time
1	recognition of unresponsiveness			
2	recognition of respiratory failure (apnea)			
3	recognition of circulatory failure (pulselessness)			
4	call for help and defibrillator			
5	establishment of team structure with role assignment			
6	deployment of appropriate communications and teamwork behaviors			
7	basic airway management (100% oxygen administration with bag-valve-mask ventilation)			
8	"quick-look" rhythm analysis (non-shockable rhythm recognition)			
9	basic circulatory management (CPR)			
10	advanced airway management (endotracheal intubation or laryngeal mask airway deployment, placement confirmation and securement, ventilator management)			
11	advanced circulatory support (cardiac monitor, vasoactive agents [epinephrine, vasopressors], peripheral + central venous access)			
continued				

	Critical Action	Yes	No	Time
12	PEA recognition (i.e. continues CPR, does not defibrillate or cardiovert)			
13	PEA evaluation and management (reviews differential diagnosis, implementation of specific testing and treatment)			
14	recognition of massive PE as probable source of PEA			
15	recognition of progressive deterioration of PEA into recurrent pulseless ventricular tachycardia (VT)			
16	institution of thrombolytic therapy			
17	continued respiratory and circulatory support after thrombolytic administration			
18	supportive therapies upon improvement of circulatory function			
19	critical care medicine consultation			
20	disposition to critical care setting			

ACGME Competencies		
Competency	Required Skill	Check
<i>Patient Care</i>		
	Caring and respectful behaviors	
	Interviewing	
	Informed decision-making	
	Develop & carry out patient management plans	
	Performance of procedures	
	a) Routine physical exam	
	b) Medical Procedures	
	Work within a team	
<i>Medical Knowledge</i>		
	Investigatory and analytic thinking	
<i>Practice-Based Learning and Improvement</i>		
	Analyze own practice for needed improvements	
	Use of information technology	
	Facilitate learning of others	
<i>Interpersonal & Communication Skills</i>		
	Creation of therapeutic relationship with patients	
	Listening skills	
<i>Professionalism</i>		
	Respectful, altruistic	
	Ethically sound practice	
<i>System-Based Practice</i>		
	Understand interaction of their practices with the larger system	
	Knowledge of practice and delivery systems	
	Practice cost-effective care	

Teamwork Assessment Form

Date _____ Unit _____ Team _____ Shift _____

1. Maintain Team Structure & Climate	
a. Establish the leader	
b. Designate roles and responsibilities	
c. Communicate essential team information	
d. Resolve conflicts constructively	
Overall rating:	
2. Plan & Problem Solve	
a. Engage team members in the decision making process	
b. Identify established protocol to be used or develop a plan	
c. Communicate the plan to teammates	
d. Cross monitor actions of team members	
Overall rating:	
3. Communicate with the Team	
a. Effective use situational awareness updates	
b. Call out critical information during emergent events	
c. Use check-backs to verify information transfer	
d. Systematically hand off responsibilities during team transitions	
Overall rating:	
4. Manage Workload	
a. Re-prioritize patients care in response to overall caseload of team	
b. Execute team established plan	
c. Balance workload within the team	
d. Request assistance for task overload	
Overall rating:	
5. Improve Team Skills	
a. Conduct event reviews	
b. Conduct shift reviews	
Overall rating:	

Very Poor	Poor	Marginal	Acceptable	Good	Very Good	Superior
1	2	3	4	5	6	7

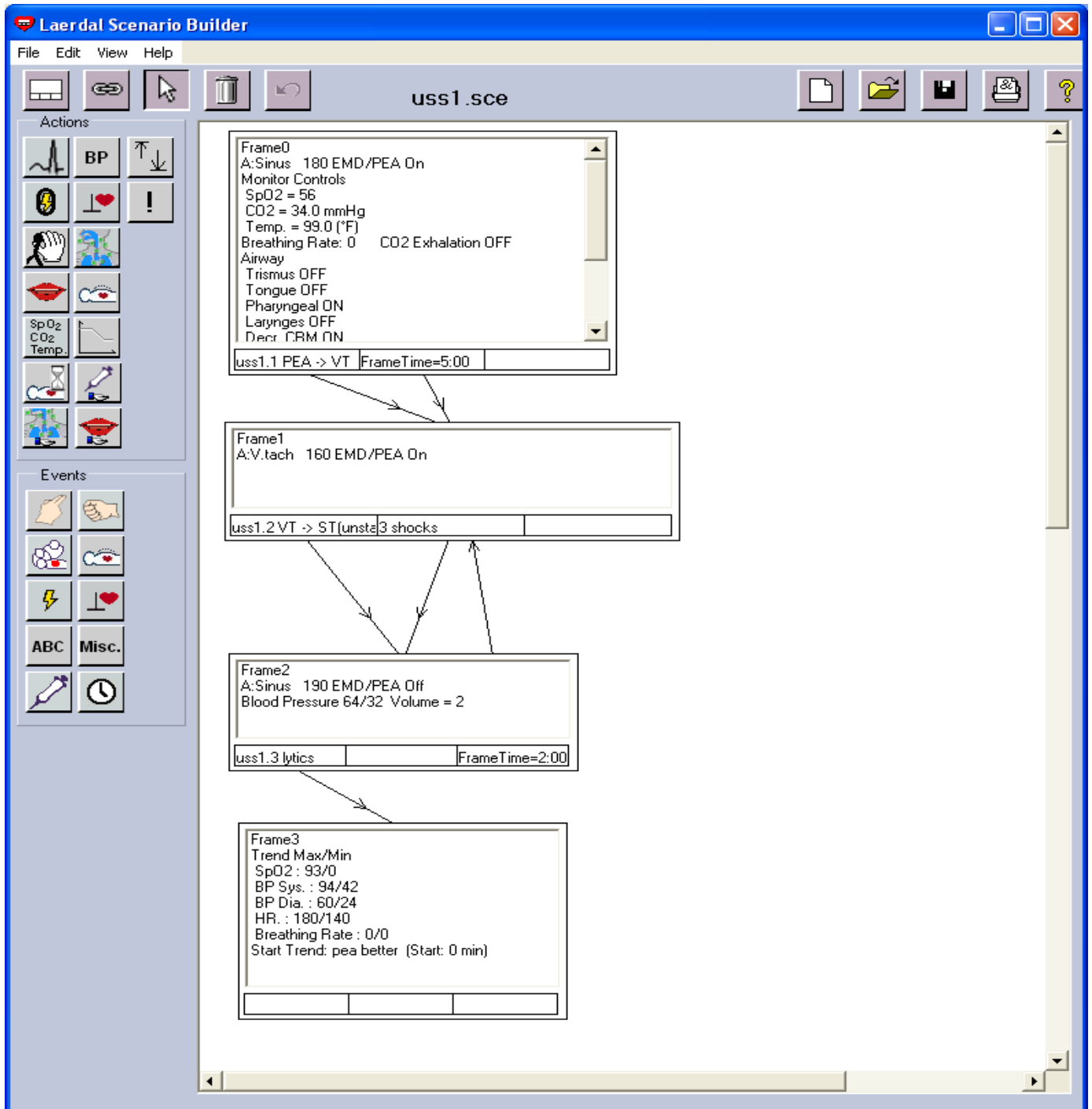
Teamwork Assessment Form

Likert Scale Descriptors

1. Very Poor
 - ❖ Teamwork principles operating minimally
 - ❖ Evidence of a hostile negative environment
2. Poor
 - ❖ Elements of teamwork observed about ten percent of the time
3. Marginal
 - ❖ Elements of teamwork observed about twenty-five percent of the time
4. Acceptable
 - ❖ Elements of teamwork observed about fifty percent of the time
5. Good
 - ❖ Elements of teamwork observed about seventy-five percent of the time
6. Very Good
 - ❖ Elements of teamwork observed about ninety percent of the time
7. Superior
 - ❖ Elements of teamwork observed ninety-eight percent of the time

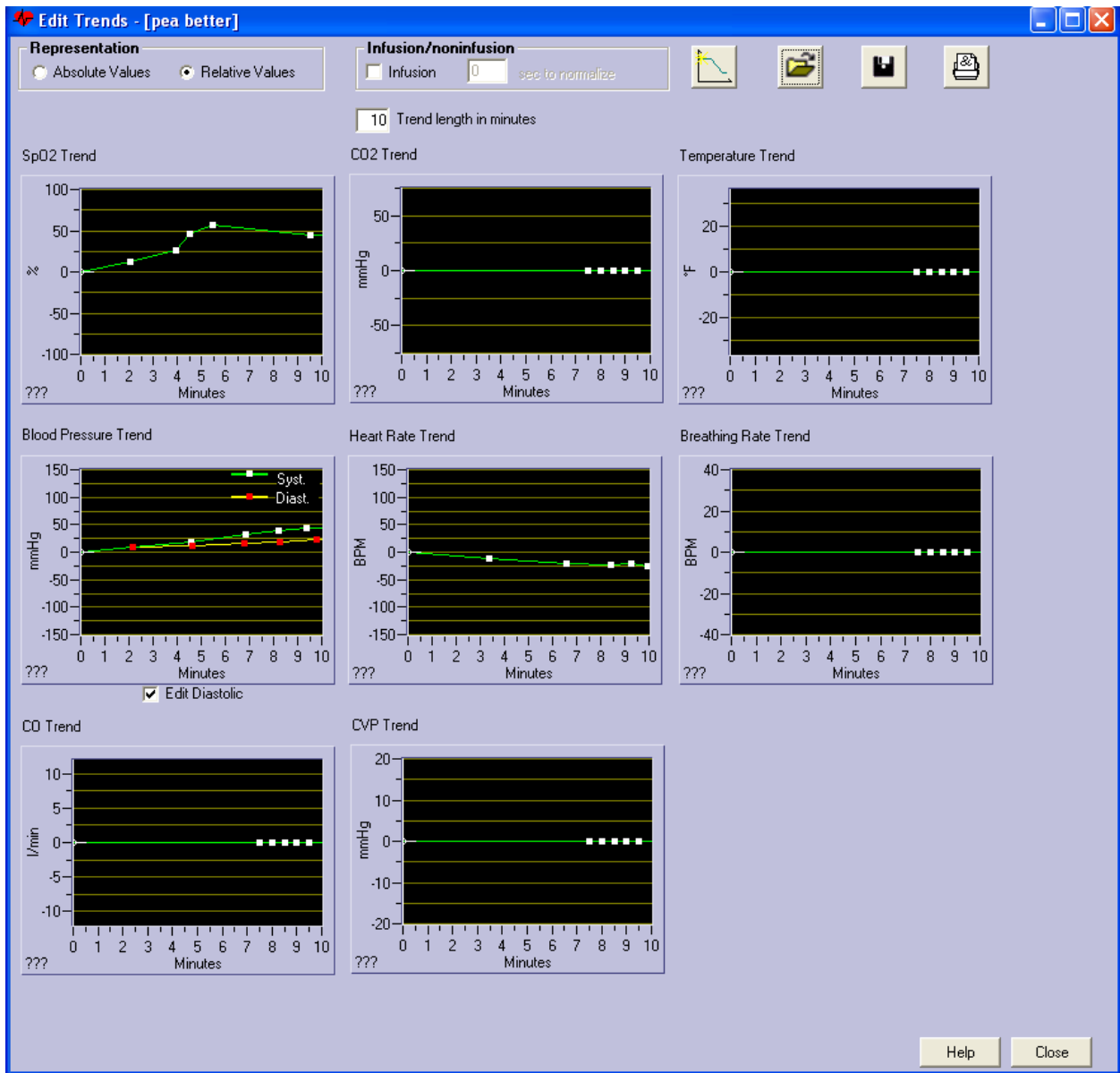
Appendix B

Laerdal SimMan v2.2 scenario content



Note: The events to force transitions to a new frame will need to be edited via the “Edit Event Menus” feature within Scenario Builder, i.e. “1. pea -> vt” “2. vt -> st (unstable)” and “3. lytics”

Laerdal SimMan v2.2 trend content



Note: The trend data points will have to be entered manually via the “Edit Trends” feature.