

Supplementary Appendix S1: Complete simulation scenario protocol and algorithm

Section A: Prior to scenario start

Standardized participant instructions on scenario execution

Checklist group

You are about to participate in a simulation scenario in which you will manage a critically ill patient in the Emergency Department. You have been randomized to execute this scenario with access to a paper-based checklist. While you are not obligated to use it, please utilize it as you would in real-world clinical practice if such a tool were available in your resuscitation bay.

You are the sole physician present, acting as both team lead and hands-on clinician. You will be assisted by an imaginary, non-obstructive nurse who will execute your orders. Provide clear, explicit instructions—for example, when ordering medication, state the specific drug name and dose. The nurse will provide closed-loop communication confirming when medication has been administered or when an infusion has completed.

The scenario will end when 15 minutes have elapsed, when instructed to stop by the lead instructor, or when you believe you have completed all interventions within your knowledge and capability. In the latter case, state clearly: "I cannot think of any further interventions." The scenario will then be terminated immediately.

Treat this scenario as you would a real patient. Clinical examination findings will be verbally provided by the lead instructor upon request.

Shortly, the case briefing will be read aloud. The diagnosis will be straightforward based on the handover provided by Emergency Medical Services (EMS); this scenario focuses on patient management rather than identifying hidden pitfalls or trick diagnoses. Following the EMS handover, you will have 2 minutes to prepare, during which the paper checklist will be provided to you.

Control group

You are about to participate in a simulation scenario in which you will manage a critically ill patient in the Emergency Department. You have been randomized to execute this scenario without a standardized checklist. If desired, you may use your own cognitive aids, such as personal notes, departmental guidelines, or online clinical resources. Feel free to access any reference materials you would typically utilize when managing a similar patient in your resuscitation bay.

You are the sole physician present, acting as both team lead and hands-on clinician. You will be assisted by an imaginary, non-obstructive nurse who will execute your orders. Provide clear, explicit instructions—for example, when ordering medication, state the specific drug name and dose. The nurse will provide closed-loop communication confirming when medication has been administered or when an infusion has completed.

The scenario will end when 15 minutes have elapsed, when instructed to stop by the lead instructor, or when you believe you have completed all interventions within your knowledge and capability. In the latter case, state clearly: "I cannot think of any further interventions." The scenario will then be terminated immediately.

Treat this scenario as you would a real patient. Clinical examination findings will be verbally provided by the lead instructor upon request.

Shortly, the case briefing will be read aloud. The diagnosis will be straightforward based on the handover provided by Emergency Medical Services (EMS); this scenario focuses on patient management rather than identifying hidden pitfalls or trick diagnoses. Following the EMS handover, you will have 2 minutes to prepare.

Scenario briefing (Read aloud to the Emergency Physician)

The resuscitation room phone rings. Emergency Medical Services (EMS) requests to give a hand-over report for an incoming patient:

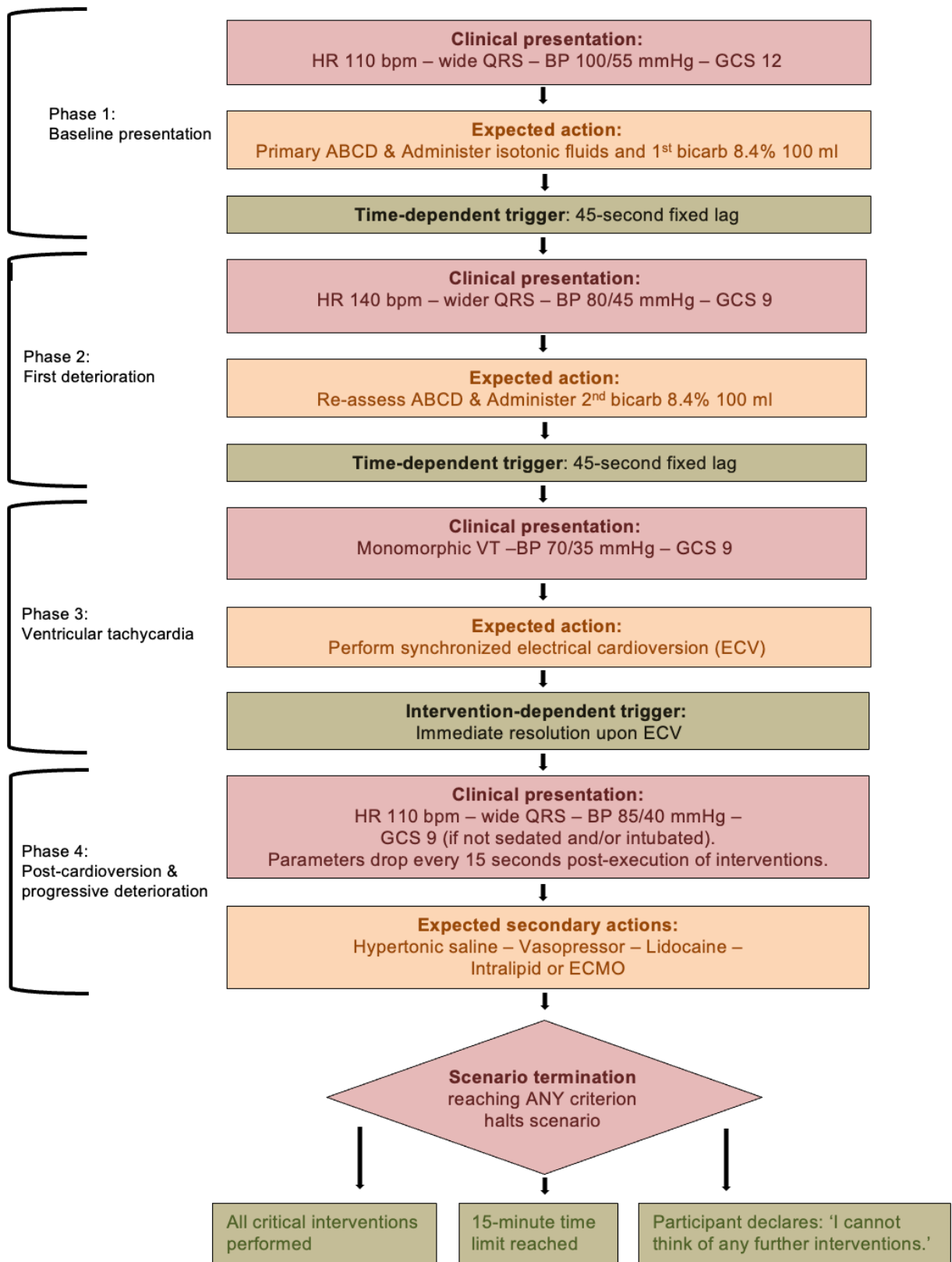
S (Situation)	EMS was dispatched for a 54-year-old male found at home by his family with an altered level of consciousness.
B (Background)	Past medical history is significant for depression, for which he is prescribed amitriptyline, a tricyclic antidepressant (TCA).
A (Assessment)	Paramedics found the patient with a reduced level of consciousness. Multiple empty blister packs of amitriptyline were discovered at the scene; the family suspects an intentional overdose due to a recent depressive relapse. The exact time of ingestion is unknown. EMS on-scene assessment & vitals: A: patent B: No respiratory distress; non-rebreather mask (NRM) applied at 15 L/min as a precaution; SpO_2 99% C: Tachycardia (~100 bpm), wide QRS complexes on ECG monitoring, blood pressure 110/60 mmHg D: 'V' on the AVPU scale (responds to Voice), no lateralizing neurological signs, blood glucose 7.8 mmol/L E: Tympanic temperature 38.0°C Treatment initiated: No medical treatments administered; 1 peripheral intravenous (IV) access site secured.
R (Recommendation)	Your task is to lead the resuscitation and manage this patient. You are working in a tertiary academic center with full access to critical care medications and interventions. EMS will arrive in 2 minutes, leaving you 2 minutes to prepare.
R (Read-back)	The Emergency Physician may briefly repeat back the handover.

Starting position manikin

Prepared in advance:

- Lying on a stretcher with a blanket over him
- NRM with 15 L/min O₂
- 1x venous access

Section B: Scenario algorithm



Section C: Operational timing rules and embedded nurse prompts

1. Operational timing rules

- Diagnostic turnaround times:
 - o 12-Lead ECG & POCUS: Delivered immediately upon physician request.
 - o Arterial Blood Gas: Result sheet provided exactly 30 seconds after request.
- Physiological State Transition Latencies:
 - o First deterioration onset: Triggered exactly 45 seconds following the initiation of the first sodium bicarbonate bolus.
 - o VT onset: Triggered exactly 45 seconds following the initiation of the second sodium bicarbonate bolus.
 - o VT resolution: Monomorphic VT terminates instantly upon execution of ECV.
 - o Late phase decay: Hemodynamic parameters drop incrementally every 15 seconds post-execution of secondary interventions during phase 4.
- Medication Administration Delays:
 - o IV Push Medications (e.g., bicarbonate, lidocaine, sodium chloride 3%): Nurse confirms administration immediately after verbal order.
 - o IV infusions (e.g., crystalloid bolus, intralipid, noradrenaline): Nurse confirms start of infusion immediately after order and completion 45 seconds later.

2. Standardized embedded nurse prompts & communication rules

The simulation nurse follows strict closed-loop communication protocol and non-directional prompting rules to maintain scenario standardization without providing clinical guidance:

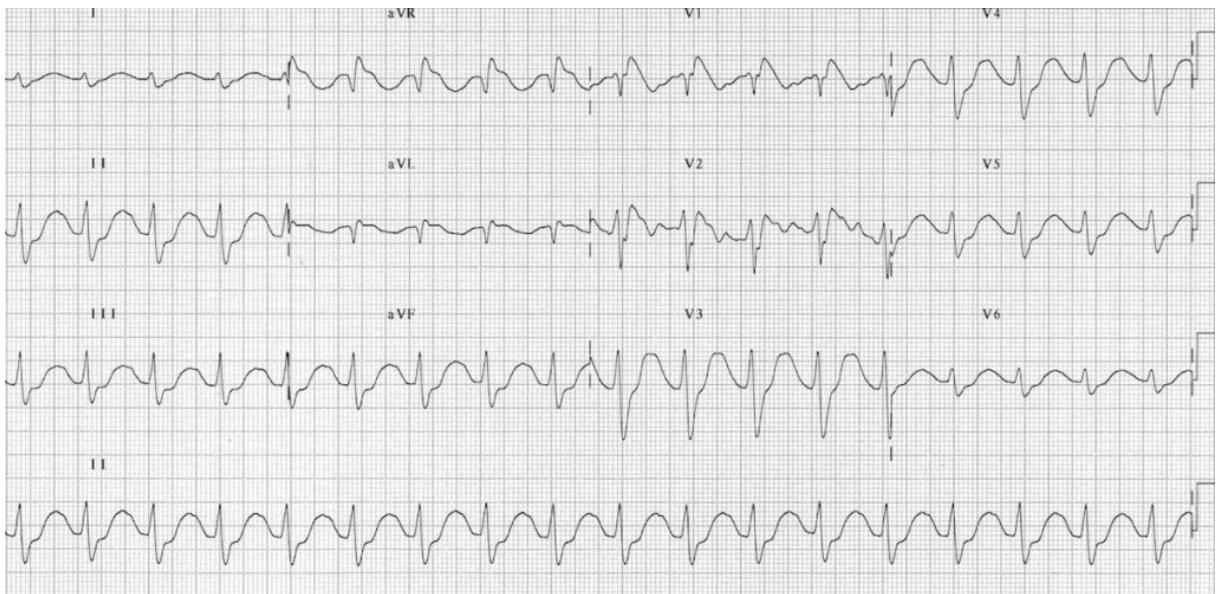
- Incomplete medication orders:
 - o Trigger: Physician orders medication without specifying dose or concentration (e.g., "Give sodium bicarbonate").
 - o Standardized prompt: "What dose and concentration would you like for the sodium bicarbonate?"
- Closed-loop action confirmations:
 - o Trigger: Execution of an ordered intervention.
 - o Standardized Prompt: "100 mL of 8.4% sodium bicarbonate has been administered IV push" or "The 500 mL sodium chloride 0.9% fluid bolus has finished running."
- Non-directive clarifications:
 - o Trigger: Physician asks nurse for clinical advice (e.g., "What should we do next?").
 - o Standardized prompt: "I am not allowed to give you advice on your management."

Section D: Detailed clinical findings and diagnostics

Clinical findings were provided verbally by the lead instructor only when explicitly requested by the participant.

Phase 1: Baseline findings

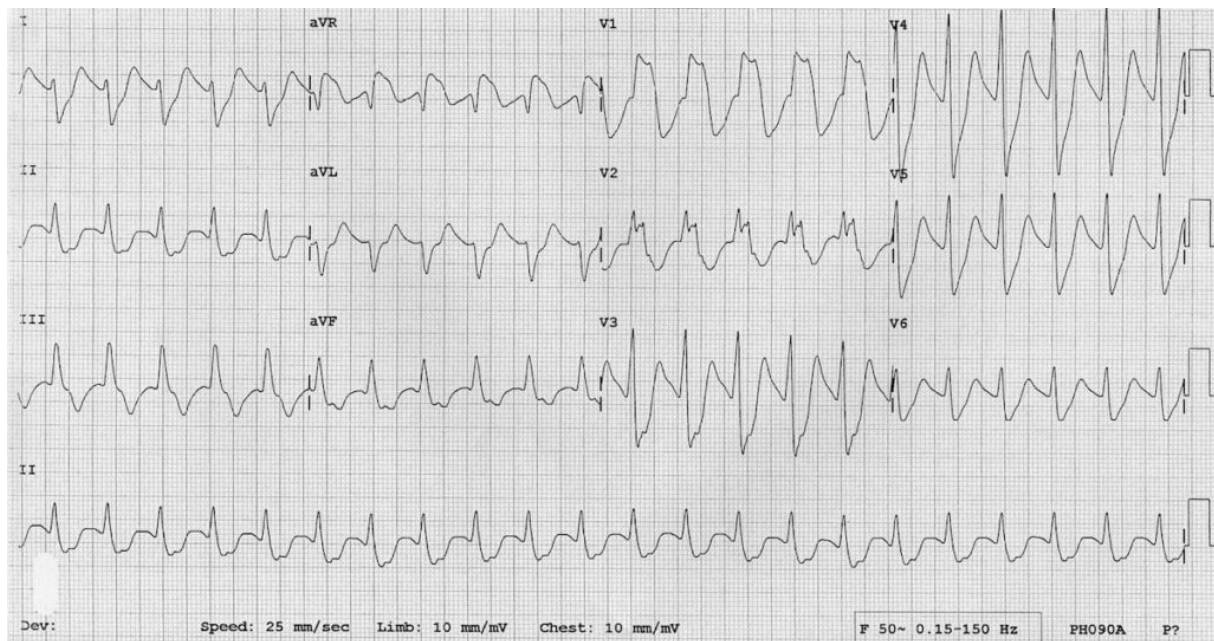
- **ABCDE Examination:** Airway patent | RR 12/min, sPO2 99% (15 L/min NRBM), clear bilateral breath sounds | BP 100/55 mmHg, HR 110 bpm (regular, wide QRS), CRT 3–4s, dry mucous membranes | GCS 12 (E3V3M6), mydriatic/sluggish pupils, hyperreflexia, glucose 7.6 mmol/L | Warm, flushed, dry skin, temp 38.0°C, urinary retention, hypoactive bowel sounds.
- **Initial diagnostics:**
 - o ECG 1: Wide-complex tachycardia (110 bpm).



- o POCUS: Mildly reduced global LV systolic contractility; otherwise normal.
- o ABG 1: pH 7.32 | pCO2 46 mmHg | HCO3 23 mmol/L | pO2 120 mmHg | Na 135 mmol/L | K 4.2 mmol/L | C 1.2 mmol/L | Cl 98 mmol/L | Glucose 7.3 mmol/L | Lactate 4.4 mmol/L.

Phase 2: First deterioration

- **ABCDE Examination:** Airway patent | RR 10/min, sPO2 98% (15 L/min NRBM) | BP 80/45 mmHg, HR 140 bpm (pronounced QRS widening) | GCS 9 (E2V2M5), glucose 7.6 mmol/L | Temp 38.0°C.
- **Diagnostics:**
 - o ECG 2: Tachycardia 140–150 bpm with progressive QRS widening.



- ABG 2: pH 7.44 | pCO₂ 48 mmHg | HCO₃ 30 mmol/L | pO₂ 89 mmHg | Na 138 mmol/L | K 4.5 mmol/L | Glucose 7.0 mmol/L | Lactate 4.8 mmol/L.

Phase 3: Ventricular tachycardia

- **ABCDE Examination:** Airway patent | RR 10/min, sPO₂ 95% (15 L/min NRBM) | BP 70/35 mmHg, pulse rapid/weak | GCS 9 (E2V2M5) | Temp 38.0°C.
- **Diagnostics:**
 - ECG 3: Monomorphic Ventricular Tachycardia (resolves immediately upon ECV delivery).



Phase 4: Post-Cardioversion & Progressive Decay

- **ABCDE Examination:** Airway patent | RR 10/min, sPO2 95% (15 L/min NRBM) | BP 85/40 mmHg, HR 110 bpm (wide QRS; values decay slightly 15s post-secondary actions) | GCS 9 (E2V2M5), glucose 7.0 mmol/L | Temp 38.0°C.
- **Diagnostics:**
 - o ECG 4: Reversion to initial wide-complex tachycardia (110 bpm).
 - o ABG 3: pH 7.59 | pCO2 50 mmHg | HCO3 40 mmol/L | pO2 75 mmHg | Na146 mmol/L | K 4.7 mmol/L | Glucose 7.0 mmol/L | Lactate 6.1 mmol/L

Special clinical management rules (intubation & sedation)

- **Neurological Assessment:** If the participant initiates endotracheal intubation and/or procedural sedation at any point during the scenario, the Glasgow Coma Scale (GCS) score immediately updates to EMV 3.
- **Monitoring & respiratory parameters:** Upon successful endotracheal intubation, respiratory monitoring transitions from spontaneous breathing parameters to mechanical ventilation monitoring, including continuous end-tidal CO2 capnography tracking.