Guide to Phase of Care Mortality Analysis (POCMA)

What Is POCMA and Why It Matters

Phase of Care Mortality Analysis (POCMA) is a structured, surgeon-directed methodology for analyzing operative mortality by identifying where in the continuum of care the cascade leading to death began. Rather than asking who was responsible, POCMA focuses on what phase of care and what process or decision served as the seminal event.

POCMA was developed and adopted statewide by the Michigan Society of Thoracic and Cardiovascular Surgeons (MSTCVS) as a central quality improvement tool. All Michigan cardiac surgery programs participate voluntarily, and cases are reviewed collaboratively in a confidential peer-review environment.

Benefits of POCMA:

- Promotes systems-based thinking rather than isolated technical critique
- Provides a consistent framework for mortality review
- Identifies actionable opportunities to prevent future deaths
- Supports transparent, non-punitive peer learning

Conceptual Foundation of POCMA

The conceptual foundation of POCMA comes from early work defining modes of death after coronary artery bypass grafting (CABG)[1]. This work demonstrated that deaths following cardiac surgery are not random, but follow recognizable patterns related to processes and systems of clinical care.

Key concepts include:

- **Defined modes of death**: Mortality can be categorized based on where and how the clinical course begins to fail.
- **The seminal event:** Different processes and systems of clinical care yield different outcomes. Variation in judgment, execution, and care delivery, not chance, drives results.
- **Avoidability is implied:** Understanding the relationship between care processes and outcomes reveals opportunities for prevention and improvement.

POCMA in Michigan: Statewide Adoption and Evolution

POCMA was operationalized and refined through the MSTCVS Quality Collaborative, creating one of the earliest statewide, surgeon-led mortality analytics programs in the United States.

Key milestones include:

- 2006: MSTCVS Quality Collaborative established
- 2006–2007: POCMA introduced and first statewide case submissions completed
- 2007: Decision tree refined and project formally validated
- 2008–present: Dedicated database and ongoing statewide review

Early statewide results demonstrated the impact of this approach:

- 1,905 mortalities reviewed among 53,674 adult cardiac operations (2006–2010)
- Clear profiles of seminal events across phases of care identified
- 41% of deaths determined to be potentially avoidable

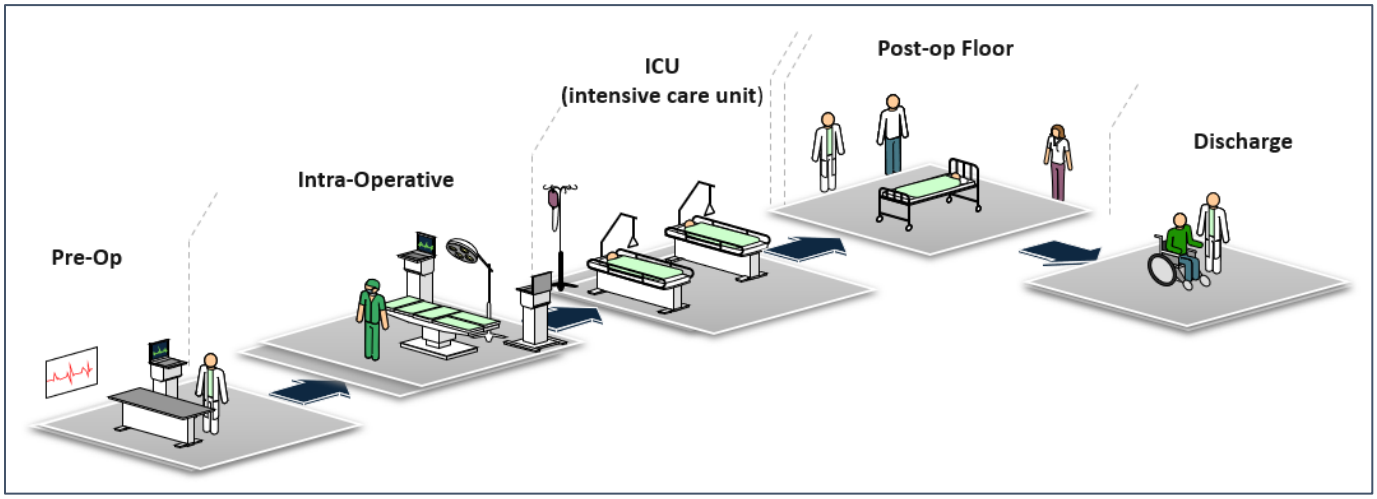
Methodology of POCMA

POCMA is a systematic, surgeon-directed methodology that evaluates the entire clinical episode of surgical care.

Systems Concept of Care

Surgical care occurs across sequential, interdependent phases:

- Pre-operative
- Intra-operative
- Post-operative ICU
- Post-operative floor
- Discharge



Each phase has unique goals, teams, tasks, and risks. The central task of POCMA is to determine in which phase of care the seminal event that initiated the fatal cascade occurred.

Deaths most often reflect failures of process, judgment, execution, surveillance, or handoff within a specific phase of care.

Surgeon-Level Review and Statewide Process

When a surgical mortality occurs:

- The operating surgeon completes a POCMA form during local multidisciplinary mortality review.
- The surgeon identifies a single seminal event, assigns the phase of care, and assesses:
  - Avoidability of the seminal event
  - Certainty that the event caused death
  - Avoidability of the death
- POCMA forms are submitted to the MSTCVS QC Coordinating Center quarterly.

Submissions are reviewed by the MSTCVS Coordinating Center. Ambiguous cases are adjudicated by the Quality Committee, with final determinations fed back to surgeons and institutions for learning and quality improvement.

The Seminal Event

The seminal event is the initiating event, decision, or process failure that triggered the irreversible cascade leading to death.

Key principles:

- One seminal event is identified per case
- It occurs in a single phase of care
- Downstream complications are consequences, not causes

Detailed POCMA Phase Definitions

The following section provides standardized, refined definitions for POCMA phase-of-care designation. Language has been clarified for consistency, educational use, and alignment with MSTCVS intent.

Pre-Operative Phase

Cardiac Risk Profile

Patients with critical or irreversible cardiac dysfunction that cannot be meaningfully remediated by surgery:

- Low cardiac output syndrome (cardiac index < 1.5 L/min/m^2), acute or chronic
- Cardiogenic shock due to acute myocardial infarction
- Chronic compensated low output due to multiple prior MIs or end-stage cardiomyopathy (any etiology)
- Myocardial viability limitations, where revascularization or valve intervention is unlikely to improve survival

Non-Cardiac (Systemic) Risk Profile

Systemic comorbidity burden sufficient to preclude survival from operative stress despite optimal care, generally ≥2 major comorbidities, such as:

- End-stage renal disease on dialysis
- Cirrhosis (especially Child-Pugh B or C)
- Moderate-to-severe COPD
- Prior CVA with residual neurologic deficit
- Mesenteric ischemia or severe peripheral vascular disease
- Diabetes with end-organ complications
- Age > 80 years
- Immunodeficiency (disease-related or chronic immunosuppression)
- Protein-calorie malnutrition
- BMI > 40

Judgment Errors

- Timing of surgery: Intervention clearly too early or too late for the cardiac condition
- Risk > Benefit: Anticipated mortality from surgical stress outweighs short- or long-term survival benefit; correction of cardiac pathology does not meaningfully change prognosis

Patient Preparation

- Incomplete or inadequate medical optimization prior to surgery

Patient Evaluation

- Inadequate pre-operative evaluation or insufficient time allotted for optimization
- Failure to identify occult disease limiting life expectancy to < 12 months (e.g., metastatic malignancy, amyloidosis, advanced HIV, Child-Pugh C cirrhosis)
- Disease may have been missed due to failure to recognize clinical clues, or may have been truly cryptic and discovered only on autopsy

Other

- Specify

Attribution Note: Assignment of the seminal event to a cardiac or systemic pre-operative risk profile requires all of the following:

- Predicted operative mortality >20% by STS or EuroSCORE
- Subsequent care judged to be optimal, without introduction of additional mortality risk factors

Intra-Operative Phase

Anesthetic Care

- Technical errors: Vascular access, airway management (ET tube), TEE probe placement
- Pharmacologic management: Medication errors, inappropriate dosing, or failure to appropriately manage anesthetic agents
- Deficiencies in managing hemodynamic or metabolic instability before, during, or after CPB

Surgeon – Technical Execution

- Errors in execution of the surgical plan, including:
  - Avoidable embolization leading to CVA
  - Early CABG failure due to technical error or inappropriate target selection
  - Excessive CPB or cross-clamp times
  - Excessive yet controllable surgical bleeding
  - Inadequate myocardial protection

Surgeon – Judgment

- Errors in operative planning, approach, or intra-operative decision-making

Surgeon - Myocardial Protection

- Inadequate dosing, delivery, monitoring, or timing of myocardial protection strategies

Cardiopulmonary Bypass (CPB)

- Inadequate monitoring or management of:
  - Hematocrit < 20%
  - Inadequate pump flows or perfusion pressures
  - Embolic or low-flow cerebral events
- Fluid management
  - Excessive pump prime or inappropriate volume administration resulting in hemodynamic compromise

Cerebrovascular Accident

- Stroke resulting from embolic or hypoperfusion events occurring during surgery, attributable to operative technique, judgment, or CPB management rather than post-operative care.

Catastrophic Event

- Fatal event that could not be predicted, prevented, or managed with reasonable expectation of success
- Specify

Other

- Specify

Post-Operative ICU Phase

Hemodynamic Management

- Failure to maintain adequate perfusion after initial stabilization (first 4–6 hours), reflected by:
  - Cardiac index < 1.8 L/min/m^2
  - Inadequate oxygen delivery (e.g., low SvO_2)

Respiratory Care

- Ventilator management errors leading to:
  - Barotrauma or oxygen toxicity
  - Ventilator-associated pneumonia
- Delays in tracheostomy or inappropriate weaning/extubation strategies

ICU Care (Protocol-Based / Keystone Criteria)

- Lapses in standard ICU protocols contributing to:
  - Line-related sepsis
  - Nosocomial infection (e.g., Clostridioides difficile)
  - DVT/PE
  - Protein-calorie malnutrition

Multisystem Organ Failure

- Failure of two or more organ systems to recover post-operatively

Failure to Thrive

- Inability to progress due to patient or family non-participation
- Early withdrawal of support by family

Surveillance, Recognition, and Treatment of Decompensation

- Delayed or inappropriate response to evolving life-threatening complications
- Acceptable response windows depend on pathology, for example:
  - Acute tamponade: recognition and re-exploration within 1–2 hours
  - Acute bowel ischemia: intervention within 4–6 hours
- Delayed initiation of nutritional support (e.g., tube feedings)

Catastrophic Event
- Fatal event that could not be recognized, prevented, or successfully treated
- Specify

Other
- Specify

Post-Operative Floor Phase

Pharmacologic Management
- Inappropriate initiation, titration, or monitoring of:
- Beta-blockers, diuretics, ACE-I/ARB
- Antiarrhythmics (e.g., amiodarone)
- Anticoagulation (e.g., warfarin)
- Chronic non-cardiac medications (e.g., glycemic control)

Goal: adapt pharmacotherapy to reduce physiologic reserve after major surgical stress.

Pulmonary Embolism
- Strong clinical or diagnostic evidence of acute PE contributing to death

Cerebrovascular Accident
- Acute post-operative stroke with major consequences leading to death

Dysrhythmia
- Atrial or ventricular arrhythmias where delayed recognition or inadequate treatment contributed to mortality

Surveillance and Recognition
- Increased vulnerability due to higher nurse-to-patient ratios and delayed intervention times
- Delayed or inappropriate response to evolving life-threatening complications

Sepsis Prevention and Treatment
- Failure to recognize early infection or adhere to sepsis prevention protocols

Catastrophic Event
- Fatal event that could not be recognized, prevented, or successfully treated
- Specify

Other
- Specify

Discharge Phase

Disposition and Planning

- Inappropriate discharge location (home vs ECF/Rehab)
- Discharge planning not aligned with patient frailty or caregiver capability

Pharmacologic Details

- Inappropriate discharge medications
- Failure to recognize drug–drug interactions
- Inadequate monitoring of medications requiring laboratory follow-up

Instruction and Support Network

- Failure of patient or caregivers to follow prescribed instructions despite adequate education

Catastrophic Event

- Examples: patient found deceased at home, death at ECF, accidental trauma post-discharge
- Specify

Other

- Specify

Note: Assignment of causation after discharge is inherently difficult and should rely on circumstances surrounding collapse. Autopsy is strongly recommended for all post-discharge deaths.

Seminal Event (SE) Assessment

Seminal Event Avoidable ("Armchair Quarterback" Test)

- Event is modifiable
- Alternative strategy is obvious and achievable > 90% of the time
- Intended to stimulate improvement, not assign blame

Death Avoidable

- Refers specifically to surgical death, not inevitable natural death
- Includes the option that the most effective prevention would have been not operating

If avoidable: Document specific changes implemented to prevent recurrence.

References

1. O'Connor, G. T., Birkmeyer, J. D., Dacey, L. J., Quinton, H. B., Marrin, C. A. S., Birkmeyer, N. J. O., Morton, J. R., Leavitt, B. J., Maloney, C. T., Hernandez, F., Clough, R. A., Nugent, W. C., Olmstead, E. M., Charlesworth, D. C., & Plume, S. K. (1998). Results of a regional study of modes of death associated with coronary artery bypass grafting. The Annals of Thoracic Surgery, 66(4), 1323–1328. https://doi.org/10.1016/S0003-4975(98)00762-0
2. Shannon, F. L., Fazzalari, F. L., Theurer, P. F., Bell, G. F., Sutcliffe, K. M., & Prager, R. L. (2012). A method to evaluate cardiac surgery mortality: Phase of care mortality analysis. *The Annals of Thoracic Surgery, 93*(1), 36–43. https://doi.org/10.1016/j.athoracsur.2011.07.057