Failure to Rescue

Paul Chung, MD
April 6, 2017
Case Presentation

HPI
- 35M presents to ED with 3 days of N/V, anorexia, dehydration
- Non-radiating pleuritic pain exacerbated by deep breath a/w SOB x2 weeks

PMHx/PSHx
- Chronic knee pain (traumatic sports injury)

FHx
- No history of cardiac disease in family

HPI
- ½ pack Tobacco x8 years, no EtOH, +marijuana
Case Presentation

Vitals
● T: 97.0
● HR: 79
● BP: 139/80
● RR: 13

Physical Exam
● Gen: AAOx3
● Chest: CTA B/L, no wheezes/rhonchi/rales, Left chest TTP
● CV: S1S2 RRR, no murmurs/rubs/gallops
● Abd: non-distended, non-TTP all quadrants, no rebound/guarding
● Ext: no pitting edema B/L
Case Presentation

Labs
- Na+: 135
- K+: 2.6
- Mg2+: 2.3
- BUN/Cr: 41/1.50
- WBC: 16.2
- Hb: 14.2
- Lactate: 2.8
- Troponins: 0.243

EKG
- NSR, non-specific ST changes
Case Presentation

Imaging
Case Presentation

Hospital Course
● Admitted to CCU for atypical chest pain
● IVF for AKI
● Electrolytes repleted
● Ceftriaxone/Flagyl for “Leukocytosis/Sepsis”
● TTE ordered
Case Presentation

HD 0
- TTE performed
  - AV normal
  - MV normal
  - TV normal
  - PV normal
  - Trace pericardial effusion
  - EF 55%

HD 1
- WBC normalized
- Electrolytes normalized
Case Presentation

HD 2

- Diagnosis of NSTEMI made
  - Poor effort tolerance
  - T-wave inversions in leads V2-V6 consistent with apical lateral ischemia
  - Troponin elevated to 0.3

- Cardiac Catheterization
  - Right Femoral Artery
  - Mild disease of Proximal LAD

- Pt started on medications
  - ASA 81 mg PO daily
  - Ticagrelor 90 mg PO BID
  - Rosuvastatin 20 mg PO daily
  - Metoprolol 25 mg PO BID
Case Presentation

HD 2
● Post-procedure no hematoma noted

HD 3
● Hb drop from 11.5 (01/31 @2117) → 9.9 (02/01 @0157) → 8.4 (02/01 @0608)
● CT Abd/Pelvis without contrast (02/01 @0334)
  ○ Heterogenous right retroperitoneal hemorrhage
  ○ 13 cm in transverse dimension
  ○ Extension from inguinal canal to porta hepatis region
● 2 units pRBC transfused (02/01 @0313)
● Vascular Surgery consulted (02/01 @0231)
Case Presentation

HD 3

- Vitals (02/01 @0000 - 0600)
  - HR: 73 - 91
  - BP: 92 - 116/63 - 83
- Patient in no acute distress
- No hematoma visible
- Vascular Surgery recommendations
  - FFP/PCC
  - Platelets/DDAVP
  - CBC/ABG Q4H
  - CT Abd/Pelvis with contrast if continued hemodynamic instability/acidosis
Case Presentation

HD 3

- CBC repeated 02/01 @0608
  - H/H: 8.4/25.6

- Change in vitals 02/01 @0930
  - HR: 95
  - BP: 90/47

- Cardiac arrest 02/01 @1007
  - ACLS protocol initiated
  - MTP started ➔ 6 pRBC/4 FFP/1 Platelet

- Pronounced dead 02/01 @1154
Questions?

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Overview

- Background
- Measures of Quality
- Failure to Rescue
- Hospital Characteristics
- Healthcare Provider Characteristics
- Escalation of Care
- Interventions
Background

- **Organizational Accident Theory** *(James Reason)*
  - **Person approach**
    - Errors seen as moral issues
    - Bad things happen to bad people
      - “The Just World Hypothesis”
  - **System approach**
    - Errors are to be expected
    - Errors seen as consequences and not causes
    - “Cannot change the human condition, but can change the conditions under which humans work”
    - **“Swiss Cheese Model”**
    - Accidents are a consequence of active and latent conditions

Background

- **Normal Accidents** *(Charles Perrow)*
  - **Complexity**
    - No single operator can foresee consequences of a given action on a system
  - **Tight-coupling**
    - Processes are intrinsically time-dependent
  - Inevitably lead to accidents in high-risk systems

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“I am always chagrined at the tendency of people to expect that I have a simple, easy gimmick that makes [the Naval Reactors Program] function. Any successful program functions as an integrated whole of many factors. Trying to select one aspect as the key one will not work. Each element depends on all the others”

- Admiral Hyman G. Rickover
  (“Father of the Nuclear Navy”)

Background

- **High Reliability Organizations**
  - Introduced by Gene Rochlin, Todd LaPorte, Karlene Roberts describing aircraft carriers (1987)
  - Reconceptualized by Karl Weick (1999)
    - **Preoccupation with failure**
      - Threats emerge, safety is not a given
    - **Reluctance to simplify**
      - Work is complex and dynamic
    - **Sensitivity to operations**
      - “Situation Awareness”
    - **Deference to expertise**
      - People closest to work are the most knowledgeable
    - **Commitment to resilience**
      - Assume the system is at risk for failure

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Background

- **To Err is Human: Building a Safer Health System** (November 1999)
  - Institute of Medicine (IOM)
  - Estimated 44,000 - 98,000 deaths/year from medical errors
  - Estimated $17 - 29 billion/year total costs
  - Gave birth to the modern field of patient safety
  - Concluded that majority of errors are **systems related**
    - Minority due to individual recklessness (“Bad Apple” problem)

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Measures of Quality

- Rate of complications
  - Surgical Care Improvement Program (SCIP)
  - American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP)
- Rate of mortality
  - Risk-adjusted mortality index
- Poor correlation between mortality and complication rate

Failure to Rescue

Hospital and Patient Characteristics Associated With Death After Surgery: A Study of Adverse Occurrence and Failure to Rescue.

Silber, Jeffrey H. MD, PhD; Williams, Sankey V. MD; Krakauer, Henry MD, PhD; Schwartz, Sanford MD

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- Extension of the concept of resilience
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- Extension of the concept of **resilience**
Extension of the concept of resilience

- Surgical Procedure
- Complication
- Rescue
- Mortality (Failure to Rescue)

- Patient characteristics
- Hospital characteristics
Validation of Failure to Rescue

- ACS NSQIP (2005 - 2007)
  - 84,730 patients
  - General/vascular surgical procedures
- Stratified by risk-adjusted mortality
  - 3.5% in very-low mortality hospitals (VLMH)
  - 6.9% in very-high mortality hospitals (VHMH)
- Similar rates of overall and major complications
  - Overall: 24.6% vs 26.9%
  - Major: 18.2% vs 16.2%
- Higher mortality after major complications
  - 12.5% in VLMH vs 21.4% in VHMH (p<0.0001)
- Complication and mortality rate do not correlate at the hospital level

Validation of Failure to Rescue

NTDB (2007)
- 54,713 patient records

Major complications in low-mortality hospitals vs high-mortality hospitals
- 5.9% in LMH vs 5.5% in HMH

Lower Failure to Rescue rate in LMH vs HMH
- OR 0.26 (95% CI: 0.20 - 0.39)

Failure to Rescue is the primary driver of differences in quality for trauma patients


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Failure to Rescue: Patient Characteristics

Surgical Procedure

Complication

Patient characteristics

Mortality (Failure to Rescue)

Rescue

Hospital characteristics
Failure to Rescue: Patient Characteristics

Surgical Procedure → Complication

- Rescue
- Mortality (Failure to Rescue)

Patient characteristics

Hospital characteristics
Patient Characteristics: Age

- **Michigan Surgical Quality Collaborative (2006 - 2011)**
  - 23,224 patients undergoing emergent general/vascular surgery procedures
- **Stratified by age (<75 years vs ≥75 years)**
  - Complication rates correlate poorly with mortality rate
  - FTR rates higher in high mortality hospitals: 29% lowest vs 41% highest tertile, p<0.01
  - FTR rates higher in elderly patients: 18.7% (<75 years) vs 36.1% (≥75 years), p<0.01

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Patient Characteristics: Multiple Complications

**VASQIP (2000 - 2014)**
- 266,104 patients undergoing high-mortality procedures

**Stratified by number of complications (0, 1, 2, ≥3)**
- Patients with complications: 60.9% had 1 complication
- Patients who died: 63.1% had >1 complication
- Hospital Mortality:
  - Lowest Quintile: 1 Complication: 6.7%, ≥3 Complications: 26.1%
  - Highest Quintile: 1 Complication: 11.7%, ≥3 Complications: 33.0%

**Observation of a dose-response relationship (“Complication Cascade”)**

Patient Characteristics: Race

Medicare claims data from 3,270 hospitals (2000 - 2005)
  - 4,658,594 patients undergoing general/vascular/orthopedic procedures

Stratified by teaching status (resident-to-bed ratio)
  - Teaching-intensive (RB >0.6) vs Non-teaching (RB = 0)
    - FTR in White patients: OR 0.94 (95% CI 0.92 - 0.97, p<0.001)
    - FTR in Black patients: OR 1.06 (95% CI 1.00 - 1.12, p = 0.06)

Better FTR rates in Teaching-intensive hospitals only seen in White patients

Failure to Rescue: Hospital Characteristics

Surgical Procedure → Complication

Mortality (Failure to Rescue)

Patient characteristics

Rescue

Hospital characteristics
Hospital Characteristics: Nurse-staffing Levels

NURSE-STAFFING LEVELS AND THE QUALITY OF CARE IN HOSPITALS

JACK NEEDLEMAN, PH.D., PETER BUERHAUS, PH.D., R.N., SOEREN MATTKE, M.D., M.P.H., MAUREEN STEWART, B.A., AND KATYA ZELEVINSKY

  - 5,075,969 medical discharges
  - 1,104,659 surgical discharges
- Measured hours of care
  - RN: mean 11.4 hours
  - LPN: mean 7.8 hours
  - Nurses’ Aide: mean 2.4 hours
- Proportion of care by RN (in hours)
  - Higher proportion associated with lower complication rates, lower FTR rate (p=0.05)

Hospital Characteristics: Hospital Volume

- Medicare data (2005 - 2007)
  - 37,865 high-risk cancer surgeries

- Stratified by volume
  - Very low-volume hospitals (VLVH)
  - Very high-volume hospitals (VHVH)

- Postoperative complications slightly higher in VLVH vs VHVH
  - 42.7% vs 38.9%, OR: 1.17 (95% CI 1.02 - 1.33)

- Failure to Rescue rates much higher in VLVH vs VHVH
  - 30.3% vs 13.1%, OR: 2.89 (95% CI 2.40 - 3.48)

Ghaferi AA, Birkmeyer JD, Dimick JB. Hospital volume and failure to rescue with high-risk surgery. Med Care. 2011;49(12):1076-81.
Hospital Characteristics: Quality of ICU Care

Dutch Surgical Colorectal Audit (2009 - 2011)
- 25,591 patients undergoing colorectal cancer surgeries
- 0 - 39% Failure to Rescue rate

Univariate analysis
- High hospital volume: lower FTR rate
- Academic hospital: lower FTR rate
- High ICU level (Level 3 vs Level 1): lower FTR rate

Multivariate analysis
- Level 2 or 3 vs Level 1: OR 0.72 (95% CI 0.65 - 0.88, p<0.001)

Hospital Characteristics: Resident Involvement

- ACS NSQIP (2008 - 2012)
  - 1,956,002 patients
  - 10.6% Failure to Rescue rate
- Stratified by propensity for developing major postoperative complications
- Resident involvement
  - Operative morbidity: 11.4% resident involved vs 7.8% attending alone (p<0.001)
  - Operative time: 127 minutes resident involved vs 93 minutes attending alone (p<0.001)
  - Failure to Rescue: 9.4% resident involved vs 12.4% attending alone (p<0.001)
- Resident involvement may be a surrogate for hospital structure

Hospital Characteristics: Residency Programs

  - 230,769 patients
  - 24 procedure types by 454 surgeons from 73 general surgery residency programs

Adjusted adverse event rate calculated for each residency program
  - Ranked residency programs and stratified into tertiles

Compared outcomes of bottom vs top tertile general surgery residency programs
  - 0.483% vs 0.476% mortality rate (p<0.001)
  - 9.68% vs 10.89% complication rate (p<0.001)
  - 2.68% vs 2.98% Failure to Rescue rate (p<0.001)

Hospital Characteristics: Macro vs Micro-systems

- Medicare (MEDPAR) database (2007 - 2010)
  - 1,945,802 patients undergoing high-risk surgery
- Identified Macrosystem factors when comparing FTR in VHMH vs VLMH
  - No teaching status: OR 1.08 - 1.54
  - Low nurse:patient ratio: OR 1.02 - 1.14
  - <200 hospital beds: OR 1.15 - 1.93
  - <20 ICU beds: OR 1.09 - 1.62
  - Absence of high technology: OR 1.08 - 1.58
- Macrosystem models do not account for variations
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Failure to Rescue: Macrosystem vs Microsystem

Surgical Procedure → Complication

Patient characteristics

Rescue

Mortality (Failure to Rescue)

Hospital (Macrosystem) characteristics

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Failure to Rescue: Macrosystem vs Microsystem

Surgical Procedure → Complication

- Patient characteristics

Rescue

Mortality (Failure to Rescue)

- Care-provider (Microsystem) characteristics
- Hospital (Macrosystem) characteristics
Failure to Rescue: Microsystem

[Diagram showing the relationship between Surgical Procedure, Complication, Rescue, Mortality (Failure to Rescue), Patient characteristics, Care-provider (Microsystem) characteristics, and Hospital (Macrosystem) characteristics]
Microsystem: Overview

- Review of literature
- Identifies three key domains for effective management of complications
  - Communication
  - Teamwork
  - Safety Culture
- **Paucity of data and “know-how” to implement the optimal team**
- Open area of research as applies to Failure to Rescue theory

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Microsystem: Distractions and Teamwork

- Prospective cross-sectional qualitative study
  - 90 general surgery cases over 10 months
  - Observational Teamwork Assessment for Surgery (OTAS)
    - Distraction → external staff, case-irrelevant conversation, acoustics, procedural, environment
    - Teamwork → communication, coordination, cooperation, leadership, situational awareness
    - Workload → NASA-Task Load Index
    - Stress → State Trait Anxiety Inventory (STAI)
  - Distractions ubiquitous (98% of cases)
    - Most commonly created by external staff: 6.69 (SD 4.73) per hour
  - Case irrelevant conversation negatively affects teamwork

Microsystem: How to Assess Safety Culture

**Safety Culture and Complications After Bariatric Surgery**

Nancy J. O. Birkmeyer, PhD,* Jonathan F. Finks, MD,* Caprice K. Greenberg, MD,† Andrea McVeigh, MS,* Wayne J. English, MD,‡ Arthur Carlin, MD,§ Abdelkader Hawasli, MD,|| David Share, MD, MPH,¶ and John D. Birkmeyer, MD*

- **Michigan Bariatric Surgical Collaborative (2006 - 2011)**
  - 24,117 patients undergoing bariatric surgery in 22 hospitals
  - 2 standardized safety culture rating surveys → 5 point Likert scale
    - Hospital Survey on Patient Safety and Culture
    - Safety Attitudes Questionnaire (operating room version)
    - 184 individuals took the surveys (53 surgeons, 102 nurses/technicians, 29 OR administrators)

- **Comparison between outcomes data and survey response**
  - *Serious complication rates correlate with ratings of safety culture by nurses and surgeons*
    - Nurses: excellent (1.5%), very good (2.6%), acceptable (4.6%), p<0.0001
    - Surgeons: excellent (2.1%), very good (2.6%), acceptable (4.7%), p = 0.011
  - Did not correlate with ratings by operating room administrators

Microsystem: How to Assess Safety Culture

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Microsystem: Escalation of Care

- Healthcare Failure Mode and Effects Analysis (HFMEA)
  - **Prospective risk assessment** technique developed by US Army (FMEA)
  - Assemble team → describe process → risk assessment → discuss ways to intervene → feedback
  - Ethnographic observations of 6 general surgery wards:
    - 42 hours total
    - 28 escalation events
  - Risk assessment survey by all stakeholders (n=30): 4 point scale
    - Likelihood of occurrence of event
    - Potential harm of failure to escalate
    - Detectability of problem

Microsystem: Escalation of Care (continued)

- Ethnographic observation
  - 33 core steps involved

- Risk assessment survey and score creation/validation
  - 18 hazardous failures detected

- Review of failures
  - Junior doctors
    - Failing to take accurate history
    - Failing to complete a thorough examination
    - Failing to review patient’s notes
    - Failing to initiate correct treatment
    - Failing to contact senior doctor
  - Senior doctors
    - Failing to arrange definitive management

Microsystem: Escalation of Care (continued)

- Exposes the significant vulnerabilities surgical patients face on the wards
- Failure can occur at multiple steps
  - Poor resilience and reliability in the overall system
- **Understaffing highlighted**
  - Major contributor to failure to identify and react to deteriorating patients
- **Flattened hierarchy**
  - Key property of safe system
  - Clear escalation protocol is essential
- Technology available tends to be suboptimal

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Coming Back Full Circle

- **Systems Frameworks**
  - **Organizational Theory**
    - Systems approach
  - **Normal Accidents**
    - Complexity and Tight-coupling lead to accidents in high risk systems
  - **High Reliability Organizations**
    - Mindfulness → assume the system is setup for failure
    - Resilience → ability to cope with failure

- **Healthcare Systems ≠ High Reliability Organizations**

- **Fruitful area of research**
  - Microsystems
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