The Coronary Care Unit in the New Millenium: Change and Challenges

Dan Fintel, MD

Professor of Medicine

Feinberg School of Medicine, Northwestern University

Disclosures

- I have no disclosures
- Drs. David Morrow at Harvard and Jason Katz at U. of North Carolina provided useful material for this presentation

Patient #1

- 45yo male with history of CAD, CABG
- Witnessed VT/VF arrest in the field
- Prolonged resuscitation, multiple defibrillations
- Aspiration → Acute Lung Injury (ALI)
- Vasopressor-refractory shock
- Relative adrenal insufficiency
- Refractory hypoxemia → Airway Pressure Release Ventilation (APRV)
- Paralysis, heavy sedation
- Therapeutic hypothermia (TH)

Patient #2

- 60yo female
- History of remote breast cancer
- Respiratory failure
- Progressive hemodynamic instability
- Cardiac tamponade
- Multi-system organ failure
- Mechanical ventilation
- Multiple vasopressors

Where should these patients be treated?
Who should take care of these patients?
How should these doctors and nurses be trained?

EUROPEAN SOCIETY OF CARDIOLOGY®

ESC Report

Recommendations for the structure, organization, and operation of intensive cardiac care units

Yonathan Hasin[1*], Nicolas Danchin[2], Gerasimos S. Filippatos[3], Magda Heras[4], Uwe Janssens[5], Jonathan Leor[6], Menachem Nahir[1], Alexander Parkhomenko[7], Kristian Thygesen[8], Marco Tubaro[9], Lars C. Wallentin[10], and Ilia Zakke[11] on behalf of the Working Group on Acute Cardiac Care of the European Society of Cardiology

Hasin Y, et al. Eur Heart J 26:1676-82, 2005.

AHA Scientific Statement

Evolution of Critical Care Cardiology: Transformation of the Cardiovascular Intensive Care Unit and the Emerging Need for New Medical Staffing and Training Models

A Scientific Statement From the American Heart Association

David A. Morrow, MD, MPH, FAHA, Chair; James C. Fang, MD, FAHA; Dan J. Fintel, MD; Christopher B. Granger, MD, FAHA; Jason N. Katz, MD, MHS; Frederick G. Kushner, MD, FAHA; Jeffrey T. Kuvin, MD; Jose Lopez-Sendon, MD; Dorothea McAreavey, MD; Brahmajee Nallamothu, MD, MPH, FAHA; Robert Lee Page II, PharmD, MSPH, FAHA; Joseph E. Parrillo, MD; Pamela N. Peterson, MD, MSPH, FAHA; Chris Winkelman, RN, PhD; on behalf of the American Heart Association Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation, Council on Clinical Cardiology, Council on Cardiovascular Nursing, and Council on Quality of Care and Outcomes Research

To keep pace with evolution of the contemporary CICU, our roadmap includes

- **Enhanced training to ensure development of the basic skills necessary to provide care in this setting**
- ***Opportunities* for advanced training in critical care cardiology for those who intend to specialize as a cardiac intensivist**

Morrow DA et al. Circulation 2012; 126: 1408-1428

Evolution of Critical Care Cardiology: An Emerging Need

- **Epidemiology in the CCU is changing**
- **CV conditions not seen in isolation but with an array of additional medical comorbidities**
- **Cardiac issues 1º at admission become 2º to nosocomial ICU complications**
- **Blurring of distinction between CCUs and general medical ICUs**

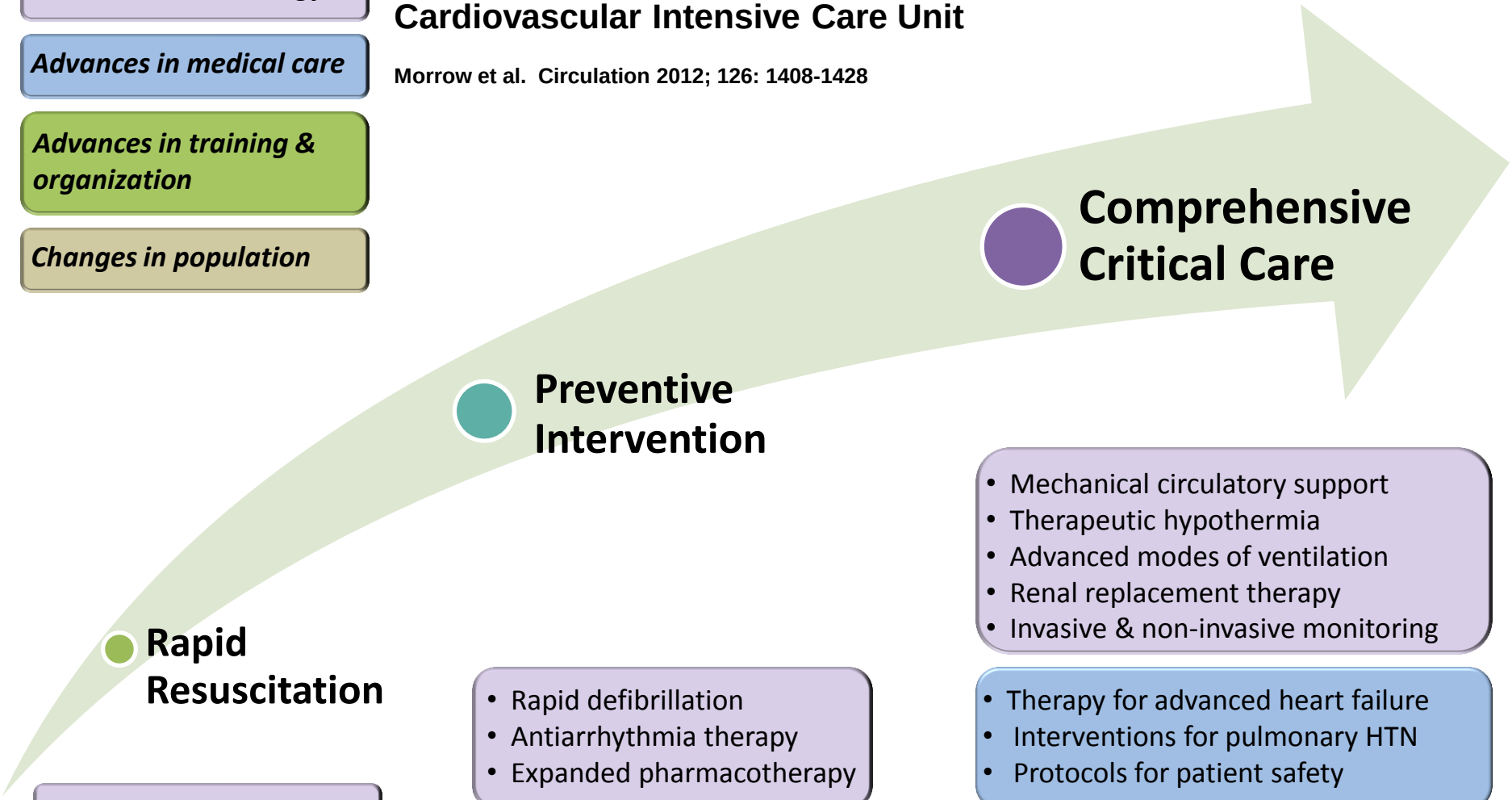
Historical Aspects of CCU Care

Dan Fintel, MD 2/5/2014

Evolution of Critical Care Cardiology: Transformation of the Cardiovascular Intensive Care Unit

Morrow et al. Circulation 2012; 126: 1408-1428

- ***Advances in technology***
- ***Advances in medical care***
- ***Advances in training & organization***
- ***Changes in population***



Rapid Resuscitation

- Rapid defibrillation
- Post-MI care
- Nurses as 1st responders
- Focus on STEMI patient

Preventive Intervention

- Rapid defibrillation
- Antiarrhythmia therapy
- Expanded pharmacotherapy

- Post-MI care
- Suspected acute ischemia

- Specialized nursing

- All ACS and heart failure

Comprehensive Critical Care

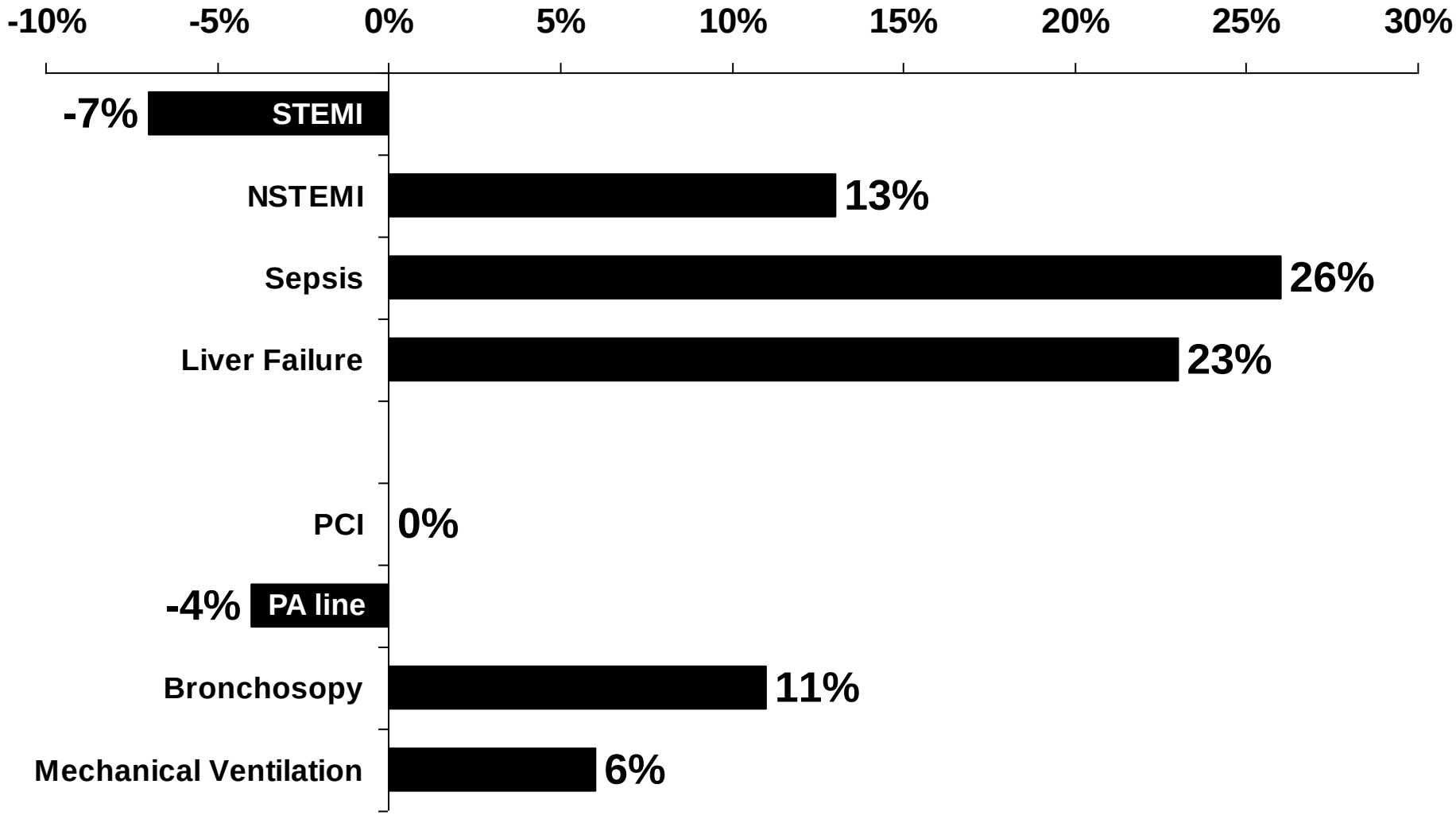
- Mechanical circulatory support
- Therapeutic hypothermia
- Advanced modes of ventilation
- Renal replacement therapy
- Invasive & non-invasive monitoring

- Therapy for advanced heart failure
- Interventions for pulmonary HTN
- Protocols for patient safety

- Advanced nursing practice
- Multidisciplinary team-based care
- Performance improvement
- Heavy use of information technology

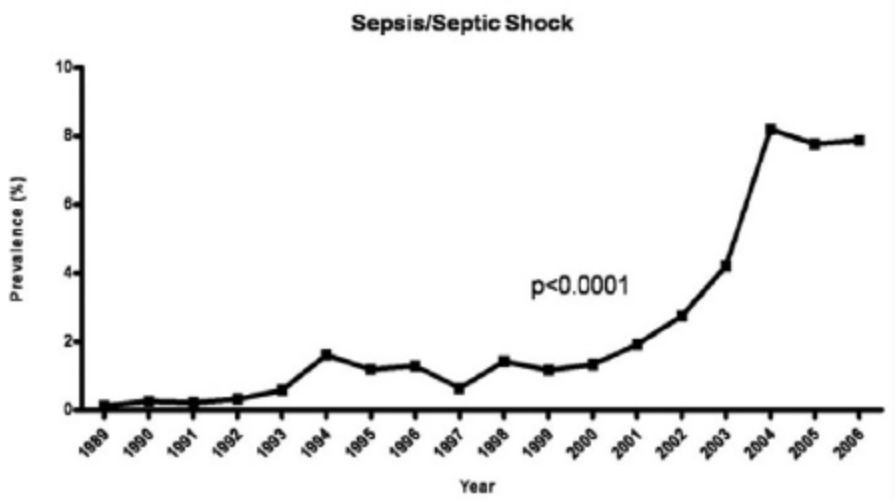
- Complex CV disease, severe comorbidity

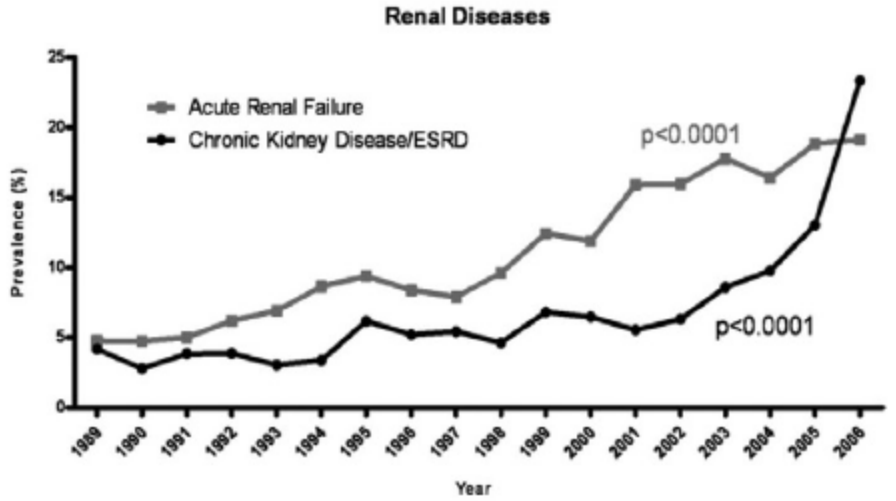
Relative Change in Odds of Diagnosis or Procedure
Duke University Medical Center CCU 1998 to 2006

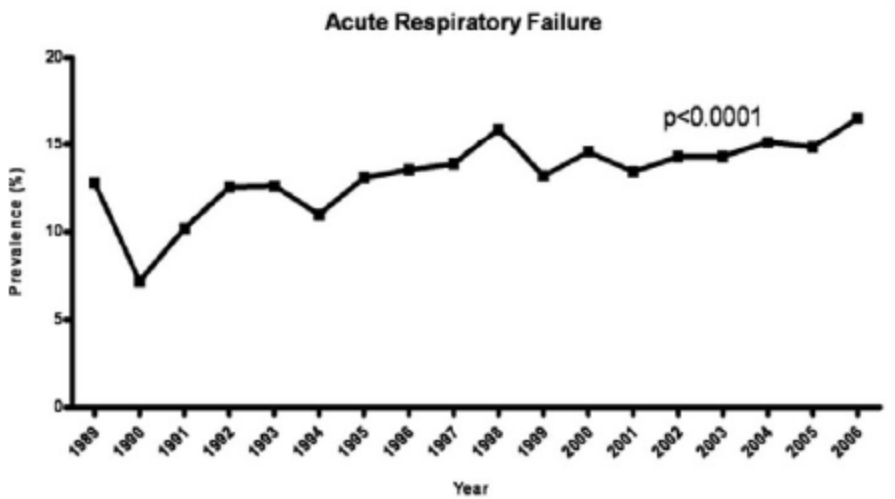


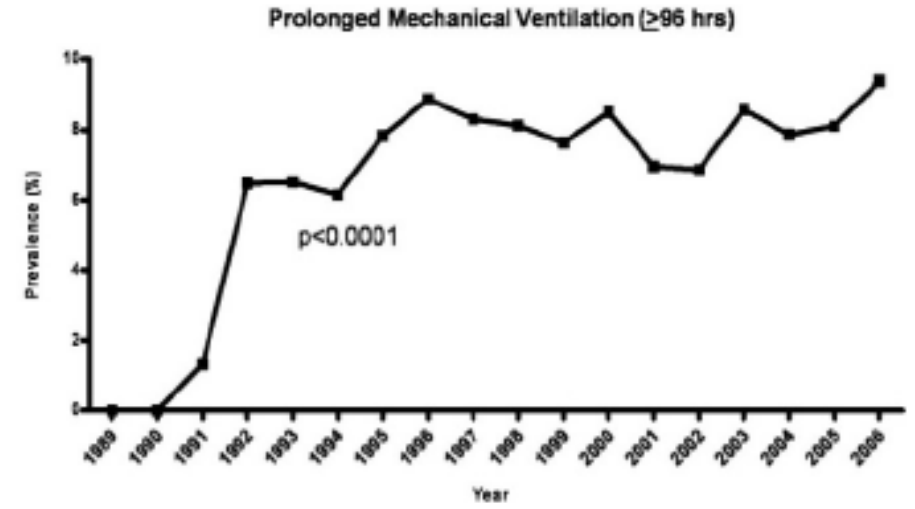
Katz JN et al; Crit Care Med 2010; 38: 375-381

Increasing Prevalence of Non-CV Illness in Tertiary Center CCU









Katz JN et al; Crit Care Med 2010; 38: 375-381

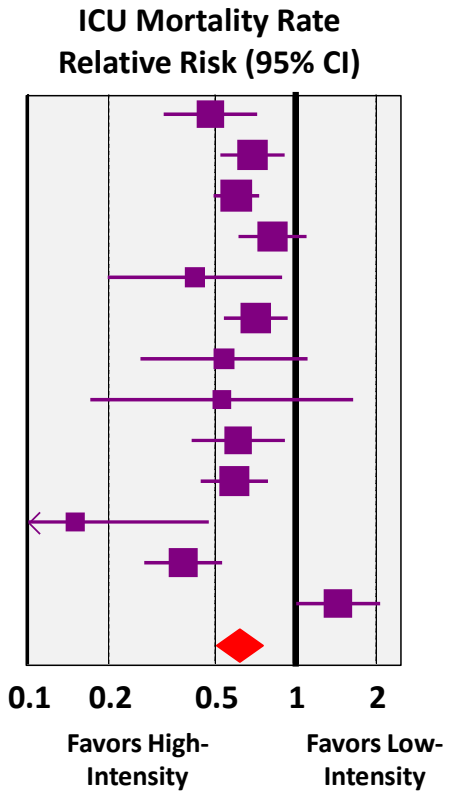
Increasing Skill Requirements for Managing MDs in the *CICU*

- **Prevention and Management of Ventilator Acquired Complications**
- **Treatment of acute lung injury**
- **Prolonged ventilation and weaning**
- **Renal replacement therapy**
- **Nutritional and metabolic mgmt**
- **ICU delirium and polyneuropathy**
- **Prevention of hospital-acquired infections**

Intensivist vs. No Intensivist

- 25% of US ICUs have an intensivist managing most patients; 50% of US ICUs have no intensivist at all

Setting	N	OR	L95	U95	p-value
Med/Surg	439	0.48	0.32	0.72	<0.001
Med/Surg	625	0.69	0.52	0.91	0.009
Surgical	667	0.60	0.49	0.73	<0.001
Medical	2409	0.82	0.61	1.10	0.19
Surgical	274	0.42	0.20	0.89	0.024
Medical	1389	0.71	0.54	0.94	0.015
Surgical	177	0.54	0.26	1.11	0.094
Pediatric	262	0.53	0.17	1.65	0.27
Med/Surg	1656	0.61	0.41	0.91	0.017
Medical	2959	0.59	0.44	0.79	<0.001
Surgical	426	0.15	0.05	0.47	0.001
Pediatric	619	0.38	0.27	0.53	<0.001
Medical	349	1.44	1.00	2.07	0.049
Overall	***12251***	***0.61***	***0.50***	***0.75***	***<0.001***



Pronovost et al. JAMA 2002; 288: 2151-2162

Emerging External Requirements

- Leapfrog Group implemented ICU Physician Staffing standard: all ICUs managed by dedicated intensivists (in 2009 met by 37% of surveyed hospitals)
- Also by Michigan Health & Safety Coalition, Florida Hospital Association, …
- American Hospital Association annual survey requires # of Intensivists we have on medical staff ➔ US News & World Report ranking of America's Best Hospitals

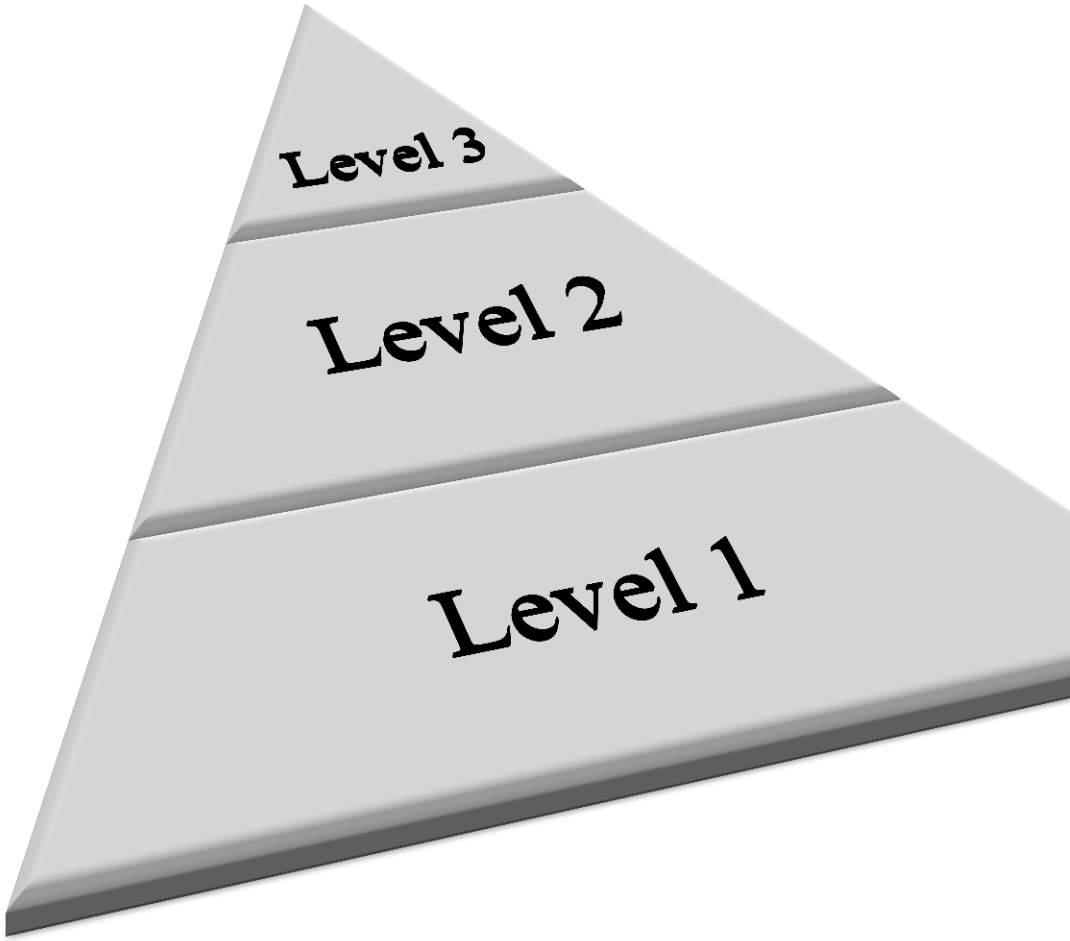
Leapfrog issues patient safety grades for U.S. hospitals

The Leapfrog Group issued an updated Hospital Safety Score report this week, giving "F" grades to 25 hospitals and "D" marks to another 121 facilities, including the Cleveland Clinic. The data show 790 of 2,618 hospitals got an "A" grade and 23% got a higher rating than in the June report. Leapfrog's scoring methodology has been criticized by some hospitals. HealthLeaders

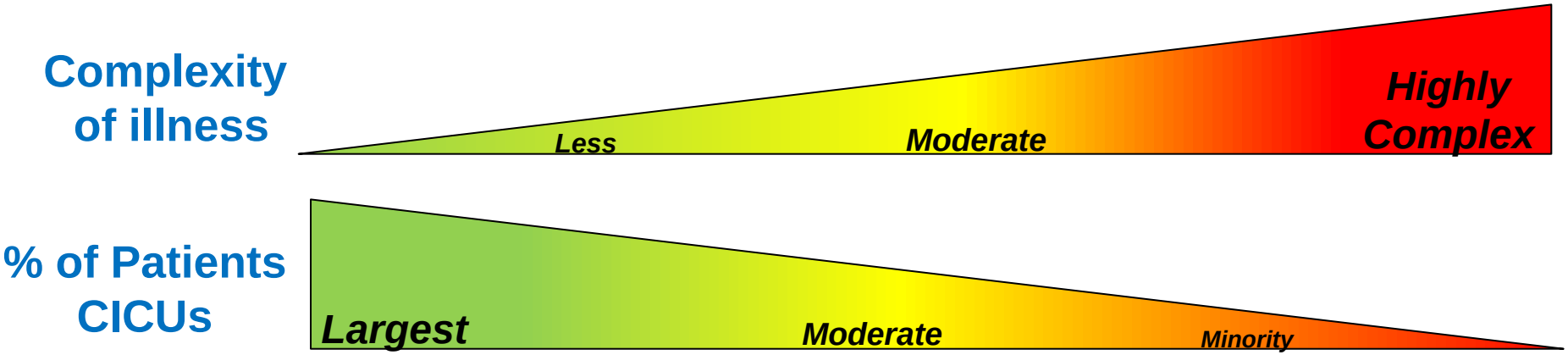
Should We Continue to Evolve?

AHA ROADMAP
Recommendations

"Categorization" of Cardiac Intensive Care Units



Care Environment in the CICU



CICU Type	Level 3 CICU	Level 2 CICU	Level 1 CICU
Example Conditions	*NSTEMI* *AF with RVR* *Most HF*	*STEMI w/ complic* *Refractory VT*	*Refractory shock* *Complex congenital* *Pulmonary HTN*
Example Resources	*Telemetry* *Mech ventil*	*IABP* *PA tailored inotropes*	*Mechanical Circulatory Support*
MD Staffing	*Cardiologist* *Intensivist available*	*Intensivist available*	*'High-intensity' cardiac or general intensivist*

Adapted by Morrow DA from Circulation 2012; 126: 1408-1428

Survey of US CICU Directors: Conclusions

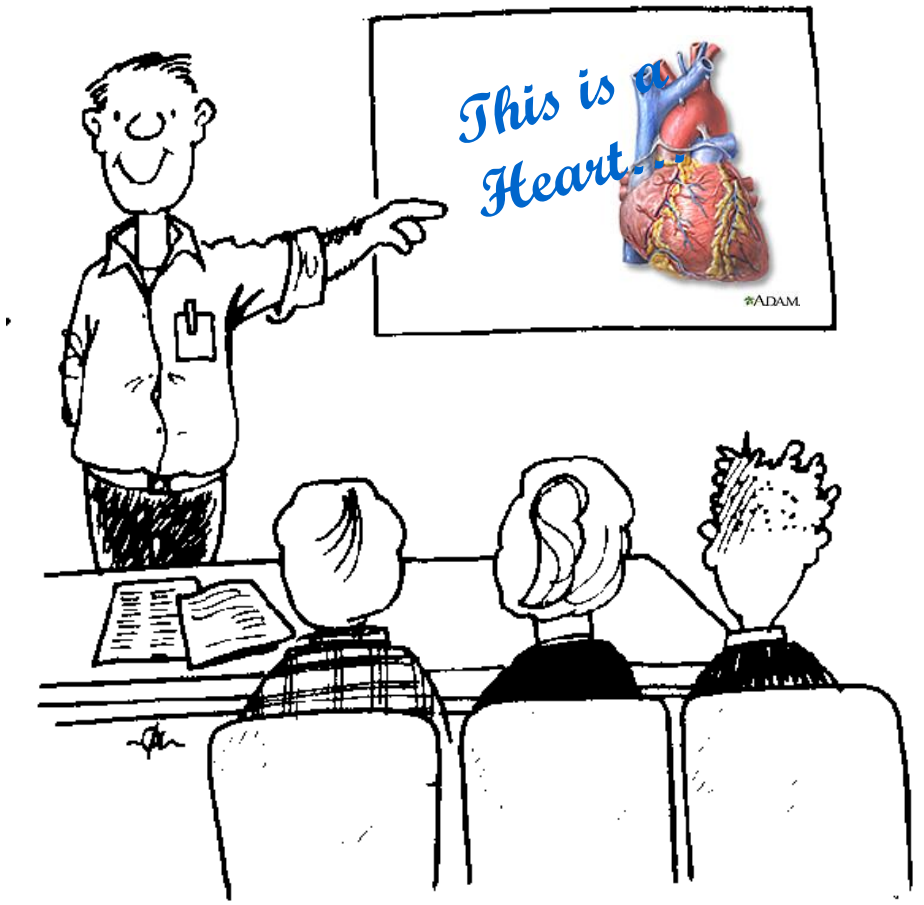
In a sample of mostly academic-affiliated hospitals

- **Most (68%) hospitals surveyed have dedicated CICUs**
  - **55% of dedicated CICUs report 'closed' unit model**
  - **Few CICUs have routine intensivist staffing**
- **Wide agreement in need for cardiologists with intensivist expertise**
- **CICU directors felt limited feasibility to develop 'closed' CICU w/ full-time cardiac intensivist staff**
- **Room for change in US CICUs to meet evidence-based staffing paradigms from general ICU literature**

O'Malley, Olenchock, Bohula-May, et al.
EHJ-Acute Cardiovascular Care 2013 (In Press)

AHA ROADMAP
Recommendations

Training Paradigms in Cardiovascular Critical Care



Training Proposals

	Current Pathway for Dual Certification	Tailored Program for Dual-Certification Critical Care Cardiology	Possible Dedicated Training Program in Critical Care Cardiology
Clinical, mo			
CVD			
Noninvasive	7	7	7
Vascular	2	2	2
Catheterization laboratory	4	4	4
Electrophysiology	2	2	2
Nonlaboratory clinical practice*	9	9 (Inclusive of below)	6 (Inclusive of below)
Advanced heart failure	...	Focused experience	Focused experience
Pulmonary hypertension	...	Focused experience	Focused experience
Outpatient continuity clinic	36	36	36
Critical care			
MICU or CICU	3 to 6	3 to 6	4 to 6
Nonmedical ICU†	3 to 6	1 to 3	3 to 6
Cardiothoracic surgery ICU	...	2 to 3	2 to 3
Research and elective, mo	12 to 18	12 to 18	12 to 18
Total months of training	48	48	48
Program faculty and leadership	Separately managed programs in CVD and critical care medicine	Integrated faculty and collaborative leadership from CV medicine and critical care medicine	Integrated faculty and collaborative leadership from CV medicine and critical care medicine
Program accreditation	Separate accredited programs: CV medicine	Accredited programs in CV medicine and critical care medicine exist within system	Integrated program in critical care cardiology with single accreditation
	Critical care medicine (1-y program)	Either the critical care medicine or CV medicine programs may have 1-y accredited program in critical care cardiology	

Basic Curriculum for CCC

Physicians who provide care for acute CV conditions requiring critical care (example skills):

- **Use and interpretation of noninvasive and invasive hemodynamic monitoring tools**
- **Appropriate use of intraaortic balloon pumps**
- **Basic management mechanical ventilation**
- **Indications for renal replacement therapies**
- **Exposure should include:**
  ACS, STEMI, cardiogenic shock, acute HF, symptomatic arrhythmias, HTN crisis, infective endocarditis, aortic dissection, pericardial tamponade, and pulmonary embolism

Beller et al. COCATS 3 Task Force 1. J Am Coll Cardiol 2008;51:333-414

Advanced Curriculum for CCC

Physicians in the modern advanced (Level 1) CICU should be experienced in managing use and complications of advanced medical technologies:

- **Complex modes of mechanical ventilation; management of ALI/ARDS**
- **Prevention of ventilator-related complications**
- **Mechanical circulatory support**
- **Inhaled pulmonary vasodilators**
- **Management of therapeutic hypothermia**
- **Nutritional and metabolic mgmt**
- **Management & prevention of ICU delirium**

Adapted by Morrow DA from Circulation 2012; 126: 1408-1428

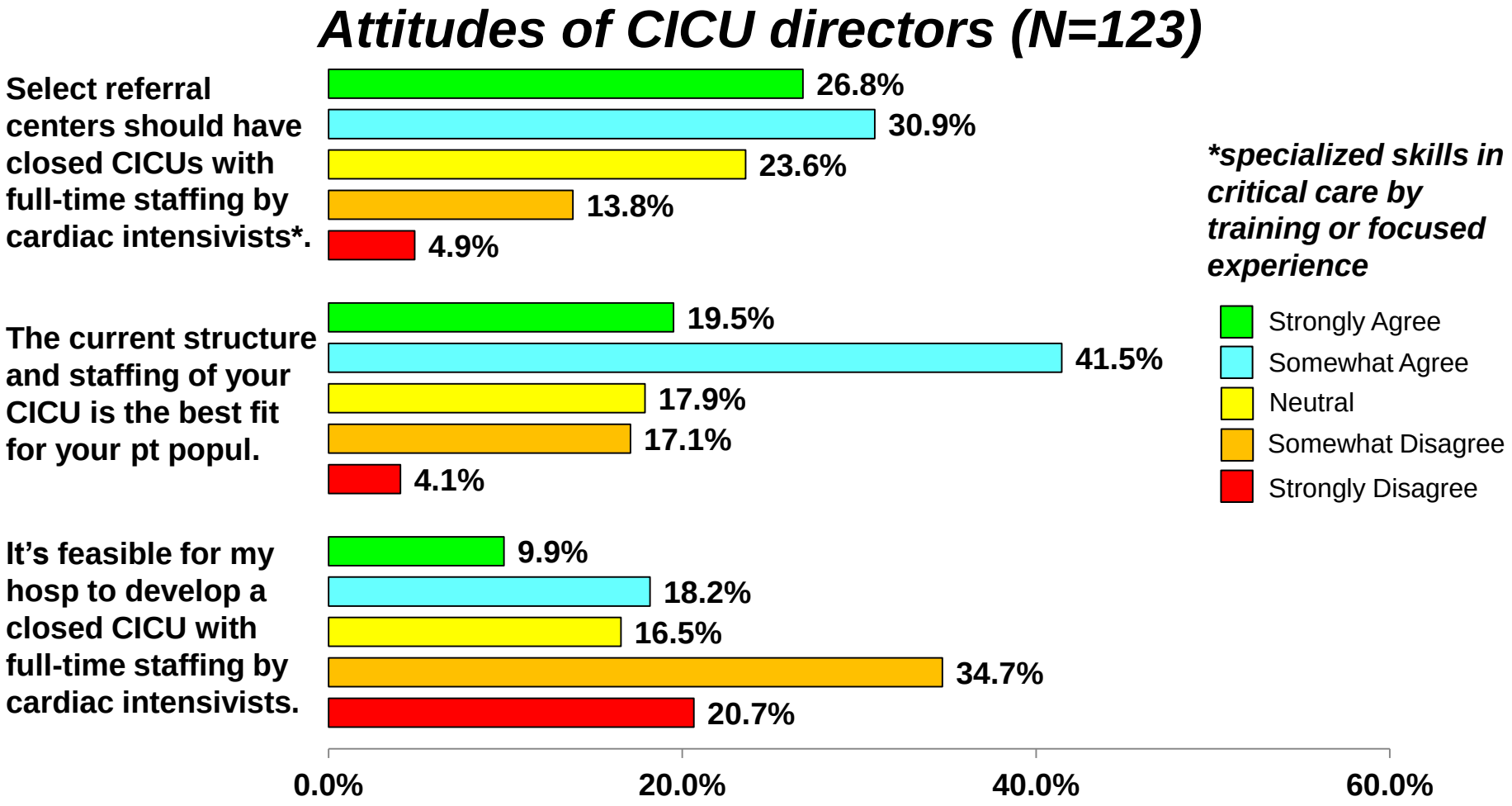
Summary

- Advances in technology, medical care, critical care unit organization, and changes in the patient population have contributed to evolution of the contemporary cardiac ICU (CICU) from a coronary care unit focused on rapid resuscitation to a unit providing comprehensive critical care for patients with CV diseases
- The continually evolving field of critical care necessitates innovative approaches to the staffing, structure, and training behind the contemporary CICU.
- Physicians in the modern CICU must be experienced in managing the use and complications of advanced medical technologies
- The future of cardiovascular critical care medicine is rapidly evolving, with an opportunity to improve the education and skills of clinicians and the care of their patients.

Dan Fintel, MD 2/5/2014

Additional Slides

Survey of US CICUs on behalf of AHA Writing Group on Evolution of Critical Care Cardiology



O'Malley, Olenchock, Bohula-May, et al.
EHJ-Acute Cardiovascular Care 2013 (Online ahead of print)

Certification in Cardiovascular (CV) Diseases & Critical Care Medicine

CRITERION	DETAILS	CV DISEASE	CRITICAL CARE
Eligibility criteria	Completion of 3 yrs of accredited cardiovascular disease fellowship and certification by the ABIM	•	
	Training within a critical care fellowship program in a department of medicine		•
Training Requirements	Completion of 24 months of full time clinical training in an accredited fellowship in cardiovascular medicine	•	
	Completion of 12 months of accredited clinical fellowship training in critical care medicine		•
	Up to six months of critical care medicine experience in cardiovascular disease and critical care medicine training can be applied to admission for both examinations	•	•
	Minimum total full-time clinical training for dual certification in cardiovascular disease and critical care medicine of 30 months (Total training time 48 months)	•	•

Morrow DA from Circulation 2012; 126: 1408-1428

Certification in Cardiovascular (CV) Diseases & Critical Care Medicine

CRITERION	DETAILS	CV DISEASE	CRITICAL CARE
Procedural Competency	Cardioversion; electrocardiography, including ambulatory monitoring and exercise testing; echocardiography; insertion and management of temporary pacemakers; and left-heart catheterization and diagnostic coronary angiography.	•	
	Advanced cardiac life support (ACLS)	•	•
	Placement of arterial, central venous, and pulmonary artery balloon flotation catheters	•	•
	Calibration and operation of hemodynamic recording systems	•	•
	Airway management and endotracheal intubation		•
	Ventilator management and noninvasive ventilation		•
	Insertion and management of chest tubes, and thoracentesis		•
	Proficiency in use of ultrasound to guide central line placement and thoracentesis strongly recommended		•
Additional Areas of Knowledge and Practical Experience	Indications, contraindications, complications, and limitations of the following procedures:		
	Intra-aortic balloon pump	•	
	Pericardiocentesis	•	•
	Transvenous pacemaker insertion	•	•
	Continuous renal replacement therapy and hemodialysis	•	•
	Fiberoptic bronchoscopy		•

Morrow DA from Circulation 2012; 126: 1408-1428

Leapfrog ICU Physician Staffing (IPS) Safety Initiative

- All adult and pediatric ICUs should be managed or co-managed by board-certified intensivists who,
- Are present during daytime hours and provide clinical care exclusively in the ICU and,
- Wher[illegible] t on-site or via telemedicine, are available by pager within [illegible] and can arrange for a FCCS-certified physician or [illegible]tender to reach ICU patients within 5 minutes

[illegible]t that, based upon current literature, over 54,000 [illegible]ould be avoided if the Leapfrog IPS [illegible]andards are implemented in all US urban hospital ICUs

Leapfrog Safe Practices Score. This means it has put in place 27 procedures to reduce preventable medical mistakes.

AHA ROADMAP Recommendations

- **Level 1 CICU**
  - All forms of invasive and non-invasive monitoring
  - Can care for advanced HF and LVAD/MCS patients
  - High intensity staffing → management by full-time intensivist (either cardiac or general) with cardiology collaboration
  - On-site nursing director; Nurse:Patient ratios of 1:1 or 1:2
  - Multidiscipilinary care team = pharmacy, nutrition, RT
  - Ready access to interventional cardiology and cardiac surgery
  - Commitment to clinical and translational research
  - ***Paradigm for most large, tertiary medical centers***

AHA ROADMAP Recommendations

- **Level 2 CICU**
  - Can provide initial evaluation & management of most acute CV conditions and medical comorbidities
  - All invasive and non-invasive monitoring is available
  - MCS available, but largely limited to IABP
  - Other therapies (e.g. CRRT) may or may not be available
  - Physician staffing by cardiologists; intensivists available for consultation or co-management of select issues
  - Nurse:Patient ratios of 1:1 to 1:3
  - ***Consider transfer to Level 1 CICU for patient requiring advanced hemodynamic support, those under consideration for high-risk surgery, or those with multisystem organ dysfunction***

AHA ROADMAP Recommendations

- **Level 3 CICU**
  - Lowest level of CICU support
  - Capacity to initially manage respiratory failure, administer vasopressors & inotropes, and provide immediate resuscitation for cardiac arrest
  - Non-invasive monitoring and echo are available
  - Critical care consultation is available
  - Nurse:Patient ratios of 1:2 or 1:3
  - Need to have systems-of-care focused on appropriate timing and destination of transfer

American Board of Internal Medicine (ABIM) Training Requirements for Specialists in Cardiovascular Disease Seeking Critical Care Certification

Eligibility Criteria

- Training conducted in Critical Care fellowship program within a Department of Medicine
- Completion of 3 years of accredited Cardiovascular Disease fellowship and certification by the ABIM

Training Requirements

- Completion of 1 year of accredited clinical fellowship training in Critical Care Medicine
- Up to 6 months of critical care medicine experience in Cardiovascular Disease and Critical Care Medicine training can be applied to admission for both examinations
- Minimum total full-time clinical training for dual certification in Cardiovascular Disease and Critical Care Medicine of 30 months

Procedural Requirements

Required Procedures

- Maintenance of an open airway
- Oral/nasal intubation
- Ventilator management
- Insertion and management of chest tubes
- ACLS
- Placement of arterial, central venous, and pulmonary artery balloon flotation catheters
- Calibration and operation of hemodynamic recording systems

Suggested Procedures

- Pericardiocentesis
- Transvenous pacemaker insertion
- Peritoneal dialysis management
- Fiberoptic bronchoscopy
- Peritoneal lavage
- Insertion of esophageal-gastric balloon for variceal bleeding tamponade