



MICHIGAN MEDICINE
UNIVERSITY OF MICHIGAN

Emergency Critical Care Center: A Lean Journey

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Lean Thinking - Things that Matter

- Customer 1st
- People are the most important resource
- Shop floor focus (Go and See)
- Kaizen is a way of life

Key LEAN Tools

- A3 Thinking
- Go and See
- Rapid Improvement Events (Kaizen)

Key LEAN Tools

- **A3 Thinking**
- Go and See
- Rapid Improvement Events (Kaizen)

Emergency Critical Care Center

Objective: Improve access to timely critical care by enhancing the capacity and capability to deliver high quality critical care in the Adult Emergency Department at the University of Michigan

10/1/2018 11:01:13

Background (Why is this important?)

Emergency Critical Care Center (ECCC) is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services.

Cause of Death in the Emergency Department

- Cardiac (35%)
- Trauma (25%)
- Stroke (15%)
- Other (25%)

Number of Intubations in the Emergency Department

- Trauma (150)
- Stroke (100)
- Cardiac (120)
- Other (180)

Analysis (What are the root causes of the problem?)

- Identify the root causes of the problem. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services.
- Emergency Critical Care Center (ECCC) is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services.
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Current Situation (Where are we now?)

The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services.

ECCC Admissions from 2014 to 2018

- 2014: 100
- 2015: 120
- 2016: 130
- 2017: 140
- 2018: 150

Future Vision (What are the proposed interventions?)

The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services.

Emergency Critical Care Center Activity Projections

- 2018: 100
- 2019: 120
- 2020: 130
- 2021: 140
- 2022: 145
- 2023: 150
- 2024: 155

Next Steps (What are we going to do?)

The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services.

Next Steps (What are we going to do?)

- 1. Patient Arrival
- 2. Triage
- 3. Assessment
- 4. Diagnosis
- 5. Treatment
- 6. Discharge/Transfer

Outcome Measures

The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services. The ECCC is a critical care unit that provides a dedicated space to provide critical care for patients who require intensive care services.

- 1. Patient mortality
- 2. Patient satisfaction
- 3. Patient length of stay
- 4. Patient cost
- 5. Patient safety

BACKGROUND/PROBLEM

Defining the problem is CRITICAL

- Why is this important?
- Why now?

Create a Clear, Concise Problem Statement

“Improve access to timely critical care by enhancing the capacity and capability to deliver high quality critical care in the Adult Emergency Department at the University of Michigan.”



Emergency Critical Care Center

Objective: Improve access to timely critical care by enhancing the capacity and capability to deliver high-quality critical care in the Adult Emergency Department at the University of Michigan

Key Concerns: Robert Newman, Jennifer Holmes, Bob Kavin, Fares Karray, Cornal Gaxiola

10/1/2019 11:41:11 AM

Background (Why is this important?)

- Critical Care is a high-stress, high-stakes environment. It is a high-stakes environment. It is a high-stakes environment. It is a high-stakes environment.
- The emergency department critical care services are currently providing a high-quality, high-stakes environment. It is a high-stakes environment. It is a high-stakes environment. It is a high-stakes environment.
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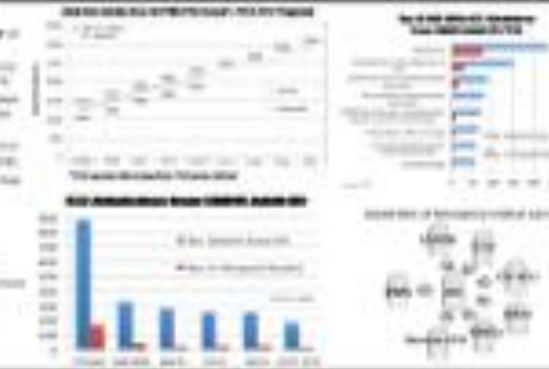


Analysis (What are the root causes of the problem?)

- Limited data availability to understand the root causes of the problem. It is a high-stakes environment. It is a high-stakes environment. It is a high-stakes environment.
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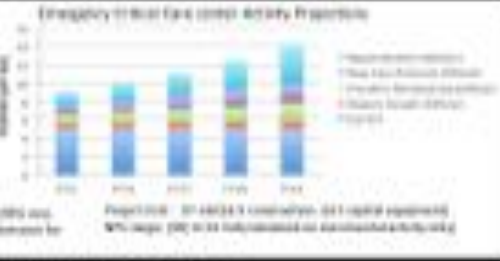
Current Situation (What do we know?)

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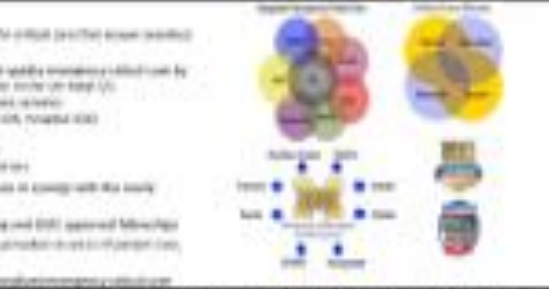
Future Needs (What are the proposed interventions?)

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How (What do we need to do?)

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Implementation Plan (What activities will be required and who will be responsible for what part of it?)

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Outcome Measures

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Background

Background (Why is this important?)

- Critical illness and injury, when considered as a single entity, is the leading cause of death in the United States.
- The national burden of critical illness and injury presenting to Emergency Departments is increasing at an alarming rate.
- This growth is expected to continue due to an aging population with increased comorbidities and complications of advanced medicine.
- The effectiveness of critical care for acute illness and injury is time-sensitive with therapeutic windows ranging from minutes to hours.
- Expansion of the United Strategic Plan to **build** **well** **high** **complexity** **medical** **centers** (HIMC to UMC) will amplify the demand for emergency critical care in our system.
- The emergency care system, in its current structure, is not prepared to respond to these challenges.

Causes of Death in the United States¹

Category	Percentage
Critical illness and injury	27%
Cancer	18%
Heart Disease	17%
Other	38%

Therapeutic Windows

Condition	Therapeutic Window
Stroke	10-18h
Trauma	1-4h
Myocardial Infarction	1-2h
Sepsis	1-6h
Organ Transplant	1-2h

Deaths of emergency care in U.S. Emergency Dept.

Category	2014	2015
Trauma	~100	~150
Myocardial Infarction	~100	~250
Stroke	~100	~150
Sepsis	~100	~150

Michigan Medicine



UMHS Admission Streams: ED = Front Door



54%

FY16 UMHS inpt/obs admissions = 66,620



16%

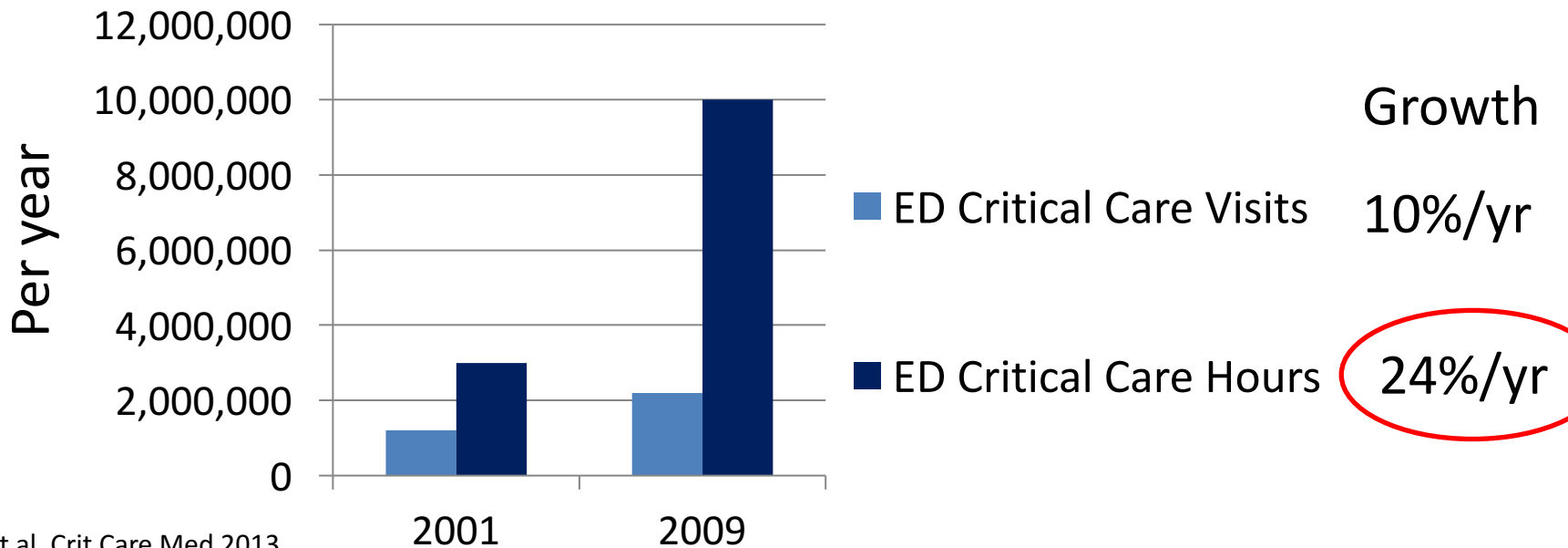


30%

An Alarming National Trend

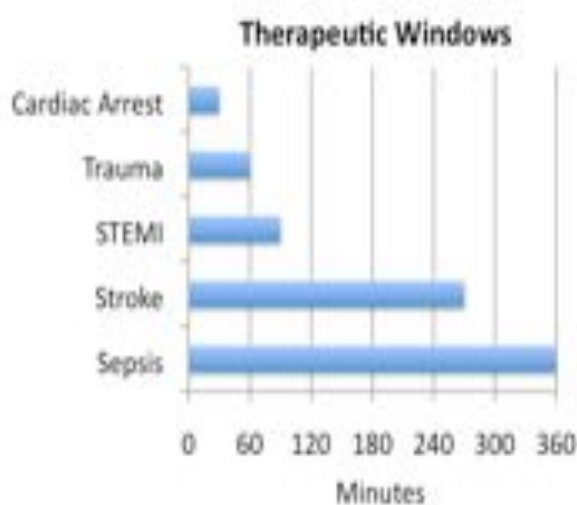
ICU admissions from the ED have DOUBLED over the last decade

- Admissions from the ED: 1.2 → 2.2 million from 2001-2009
- Admission rate from the ED: 0.9% → 1.6%
- **1/3 of all ICU admissions spend >6hrs in the ED**

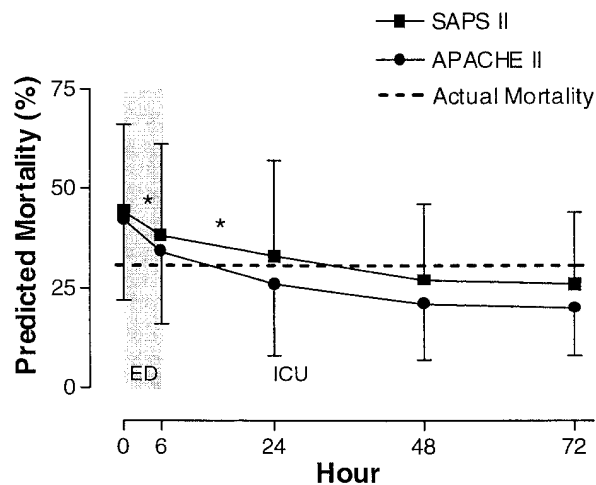


Herring et al. Crit Care Med 2013

Acute Critical Care is time-sensitive



The effectiveness of critical care for acute illness and injury is time-sensitive with therapeutic windows ranging from minutes to hours.



The FIRST 6 HOURS
Most rapid change in physiology

Nguyen 2000

ED-ICU Interface

Time 0 to 24 hr

ED Location

ICU Location

ED Team

No Man's
Land?

ICU Team

Critical Care Needs Being Addressed?

Current State/Analysis



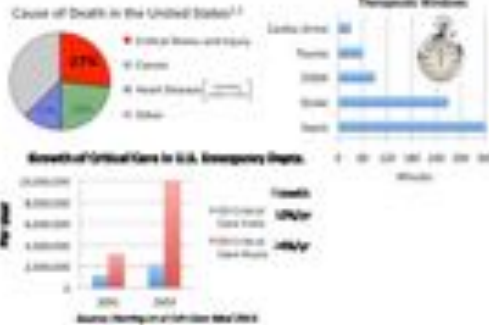


Emergency Critical Care Center

Objective: Improve access to timely critical care by enhancing the capacity and capability to deliver high-quality critical care in the Adult Emergency Department at the University of Michigan

Background (Why is this important?)

- Critical illness and injury, when considered as a single entity, is the leading cause of death in the United States.
- The national burden of critical illness and injury presenting to Emergency Departments is increasing at an alarming rate.
- This growth is expected to continue due to an aging population with increased comorbidities and complications of advanced medicine.
- The effectiveness of critical care for acute illness and injury is more sensitive with therapeutic windows (waiting from minutes to hours).
- Expansion of the EMCC Strategic Plan to include adult high acuity medical care (from 45% to 17%) will amplify the demand for emergency critical care in our system.
- The emergency care system, in its current structure, is not prepared to respond to these challenges.

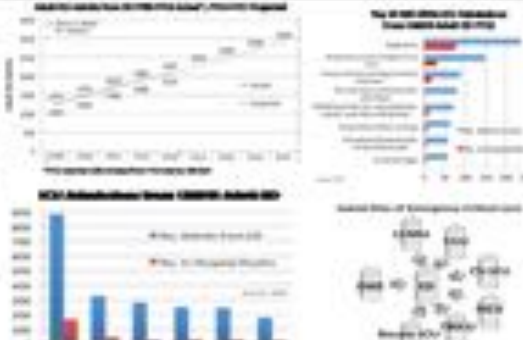


Analysis (What are the root causes of the problem?)

- Critical Care Development** is a substantially more efficient medical discipline than operations have created a dedicated space to provide critical care that addresses the specific needs of these specialties. As a result, the practice of critical care is significantly stalled.
- Emergency Critical Care** Critical Care is emerging as a distinct subspecialty of Emergency Medicine. This is driven by the expanding demand for critical care services in the ED setting and efforts to time sensitive diagnosis, therapeutics and monitoring. These capabilities have been established for ED-adjacent inpatient physicians to become eligible for critical care based certification through fellowship training in Emergency Critical Care, Surgery, and Anesthesiology pathways. This development provides a unique opportunity to integrate critical care within the health system. However, as with other specialties, a dedicated space is needed to deliver critical care in ED setting.
- ED physical plant** In the ED Adult ED, the delivery of critical care is physically dispersed and provided in rooms with inadequate space and equipment. Creation of an ED Critical Care Center (EDCC) will address this issue. Operating analysis assuming current volume, EDCC (33 beds), and EDCC expansion by 50% of ED patients initially treated in inpatient care requires 1 new addition space and 1 EDCC bed.
- ED staffing model** The initial diagnostic workup, treatment, and monitoring of ED critical care patients is resource intensive with high risk for errors of omission and commission. Florida has a 10 accreditation for the ED Adult ED. Critical care is currently provided on a 24/7 patient basis with one on one ED patient attending care. Provider staffing in an EDCC would be better matched to the level and intensity of care provided.
- Critical Care Pathway** Coordination and continuity of care for critically ill and injured ED patients is limited due to lack of agreed upon patient care pathways. A Critical Care Advisory Group was established in November 2020 to develop multidisciplinary treatment pathways for critically ill and injured patients presenting to the ED Adult ED. This group includes medical directors and nursing representation from ED, EDCC, ED, EDCC, EDCC, EDCC, EDCC. Current pathway to care include Post-Cardiac Arrest, Severe COPD, Severe Hypoxemia, Severe Asthma, Severe Anemia, Severe Sepsis.

Current Situation (Where are we now?)

- EDCC (Emergency Critical Care) is a 33-bed EDCC currently operating at 100% capacity with a 1:1 patient-to-staff ratio with a current ratio of 1:2.5. Projecting 50% annual growth.
- EDCC Medical Staff in consultation have not increased in long term. Insufficient to meet current and forecasted demand.
- EDCC Staffing: 1:1 patient-to-staff ratio for 110000 cases/year. 1:1 for 100000 cases/year. 1:1 for 100000 cases/year. 1:1 for 100000 cases/year.
- Significant volume of EDCC critical care delivered in non-critical care areas where patients are missed and/or misdiagnosed.
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Future State (What are the proposed outcomes/needs?)

Create the infrastructure and systems necessary to provide time sensitive diagnosis, treatment and monitoring of critically ill and injured patients presenting to ED Adult ED.

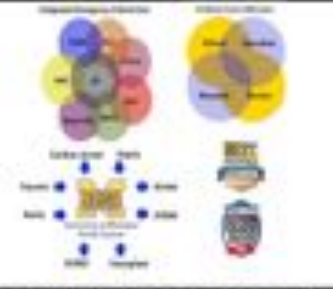
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Emergency Critical Care center Activity Projections

Project Goal: 37 and EDCC contribution to EDCC equipment 14% range (20% to 33 and 1000000 cases annually only)

Goal (Where do we want to be?)

- Support EMCC Strategic Plan
- Establish multidisciplinary patient care pathways for critical care that ensure seamless transitions from ED to inpatient ICU and beyond
- Enhance the capacity and capability to deliver high-quality emergency critical care by creating a 33-bed EDCC Emergency Critical Care Center in the ED Adult ED
- Improve timely access to critical care services
- Improve outcomes (Survival, LOS, LOS, Hospital LOS)
- Reduce patient transfers
- Reduce short stay ICU admissions
- Reduce flow ICU transfers to ED (P/W)
- Expand critical care infrastructure to critical care to operate with the newly constructed EDCC
- Develop EDCC critical care training capacity including and EDCC approval/fellowships
- Institute collaboration with inpatient critical care providers to areas of patient care, education and research
- EDCC established as Center of Excellence for specialized emergency critical care



Implementation Plan (What activities will be required and who will be responsible for what and when?)

Short-term/long-term changes to existing

- Establish Practice of Emergency Critical Care in the Dept. of Emergency Medicine
- Recruit Director/Chief and coordinate Emergency Medicine and Critical Care
- Establish scope of practice for ED Critical Care Services in the ED
- Staffing model for existing, additional, existing services
- Develop patient care protocols for Emergency Critical Care
- Establish practice in departments, base, including ED Critical Care meeting and communication network established
- Establish training/continuing education for ED faculty/fellowship/ nursing
- Establish infrastructure research capacity
- EDCC and inpatient services sign and testing
- Final space/equipment analysis, financial plan
- Facility design plan
- Facility monitoring, equipment, IT requirements
- Be prepared for a future expansion

EDCC Operational Model

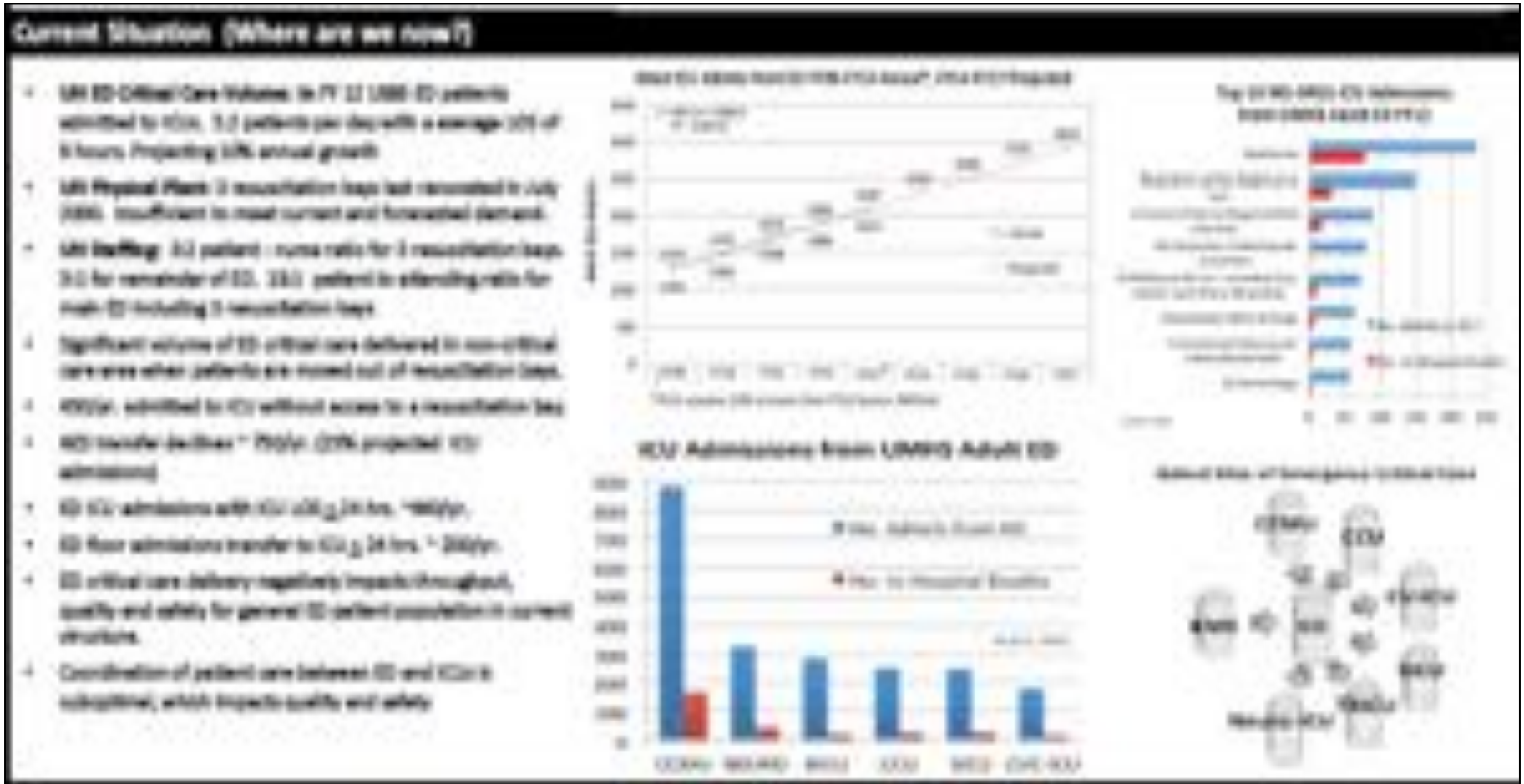
EDCC Staffing Model

EDCC Activity Projections

EDCC (Emergency Critical Care) is a 33-bed EDCC currently operating at 100% capacity with a 1:1 patient-to-staff ratio with a current ratio of 1:2.5. Projecting 50% annual growth.

1. CDC National Vital Statistics Reports, Vol 17 (1998) 2011. <https://www.cdc.gov/nchs/data/series/r18/18-0111.pdf>. 2. US ED & EDCC Survey/Analysis and Service Statistics 2019. 3. EDCC Staffing Model. 4. EDCC Operational Model. 5. EDCC Activity Projections. 6. EDCC Staffing Model. 7. EDCC Operational Model. 8. EDCC Activity Projections. 9. EDCC Staffing Model. 10. EDCC Operational Model. 11. EDCC Activity Projections. 12. EDCC Staffing Model. 13. EDCC Operational Model. 14. EDCC Activity Projections. 15. EDCC Staffing Model. 16. EDCC Operational Model. 17. EDCC Activity Projections. 18. EDCC Staffing Model. 19. EDCC Operational Model. 20. EDCC Activity Projections. 21. EDCC Staffing Model. 22. EDCC Operational Model. 23. EDCC Activity Projections. 24. EDCC Staffing Model. 25. EDCC Operational Model. 26. EDCC Activity Projections. 27. EDCC Staffing Model. 28. EDCC Operational Model. 29. EDCC Activity Projections. 30. EDCC Staffing Model. 31. EDCC Operational Model. 32. EDCC Activity Projections. 33. EDCC Staffing Model. 34. EDCC Operational Model. 35. EDCC Activity Projections. 36. EDCC Staffing Model. 37. EDCC Operational Model. 38. EDCC Activity Projections. 39. EDCC Staffing Model. 40. EDCC Operational Model. 41. EDCC Activity Projections. 42. EDCC Staffing Model. 43. EDCC Operational Model. 44. EDCC Activity Projections. 45. EDCC Staffing Model. 46. EDCC Operational Model. 47. EDCC Activity Projections. 48. EDCC Staffing Model. 49. EDCC Operational Model. 50. EDCC Activity Projections. 51. EDCC Staffing Model. 52. EDCC Operational Model. 53. EDCC Activity Projections. 54. EDCC Staffing Model. 55. EDCC Operational Model. 56. EDCC Activity Projections. 57. EDCC Staffing Model. 58. EDCC Operational Model. 59. EDCC Activity Projections. 60. EDCC Staffing Model. 61. EDCC Operational Model. 62. EDCC Activity Projections. 63. EDCC Staffing Model. 64. EDCC Operational Model. 65. EDCC Activity Projections. 66. EDCC Staffing Model. 67. EDCC Operational Model. 68. EDCC Activity Projections. 69. EDCC Staffing Model. 70. EDCC Operational Model. 71. EDCC Activity Projections. 72. EDCC Staffing Model. 73. EDCC Operational Model. 74. EDCC Activity Projections. 75. EDCC Staffing Model. 76. EDCC Operational Model. 77. EDCC Activity Projections. 78. EDCC Staffing Model. 79. EDCC Operational Model. 80. EDCC Activity Projections. 81. EDCC Staffing Model. 82. EDCC Operational Model. 83. EDCC Activity Projections. 84. EDCC Staffing Model. 85. EDCC Operational Model. 86. EDCC Activity Projections. 87. EDCC Staffing Model. 88. EDCC Operational Model. 89. EDCC Activity Projections. 90. EDCC Staffing Model. 91. EDCC Operational Model. 92. EDCC Activity Projections. 93. EDCC Staffing Model. 94. EDCC Operational Model. 95. EDCC Activity Projections. 96. EDCC Staffing Model. 97. EDCC Operational Model. 98. EDCC Activity Projections. 99. EDCC Staffing Model. 100. EDCC Operational Model.

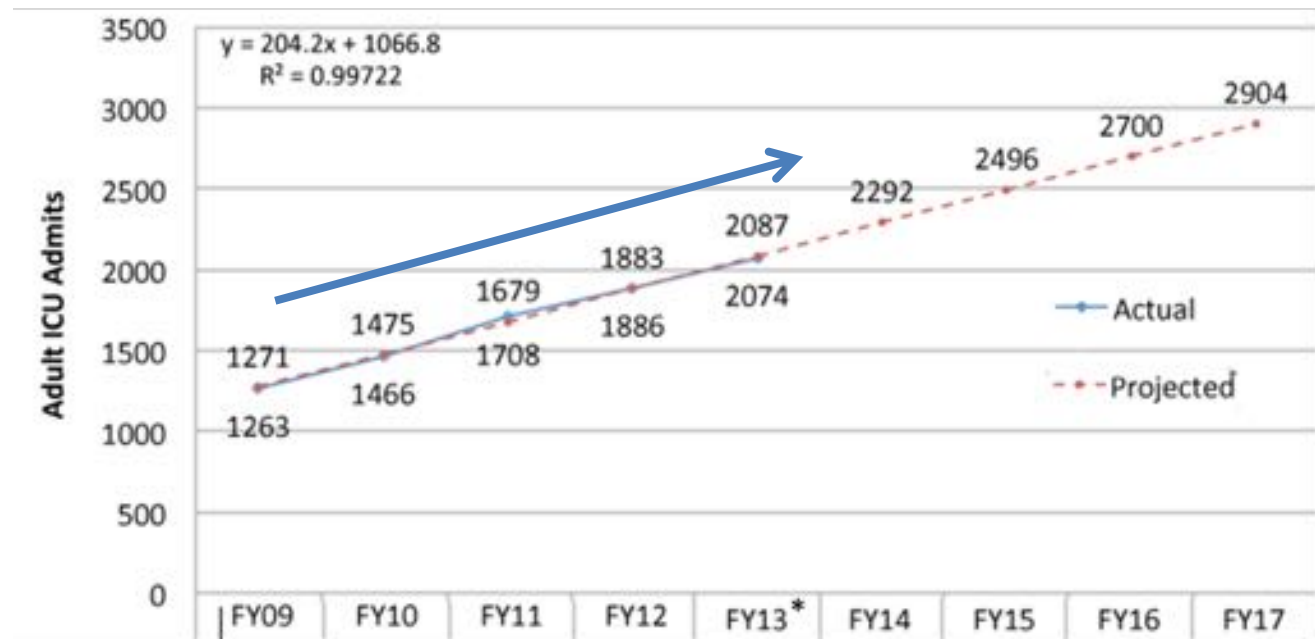
Current Situation – Where are we now?



Current state 2012 – ICU Admissions

- **FY12 – 1,886 ICU Admits**
- **5.2 per day**
- **ED LOS 6 hr**
- **Projected 10% growth**

Adult ICU Admits from ED FY09-FY13 Actual*, FY14-FY17 Projected



*FY13 assumes 10% increase from FY12 Source: MiChart

Declined ED-ED Transfer Requests (750/yr) – 25% ICU

Patient (Home/EMS/OSH)

Shunting of Resources from Non-Critical Patients

ED

CC in non-CC area (450/1286 ICU admits – 35%)

Discharge

EC3

CC D/C from ED?

Admission

CC Boarding (6 hrs)

Floor

Emergent Transfer to ICU in < 24 hrs (200/yr)

ICU

Short-Stay ICU Admissions < 24 hr (440/yr)

Summary to date (where we were in 2012)

- Increasing ED visits
- Increasing ICU demand (ED and transfers)
- Increasing ED LOS for our ICU patients
- Outcomes?

Future State/Goals



A3



Future State

Future State (What are the proposed countermeasures?)

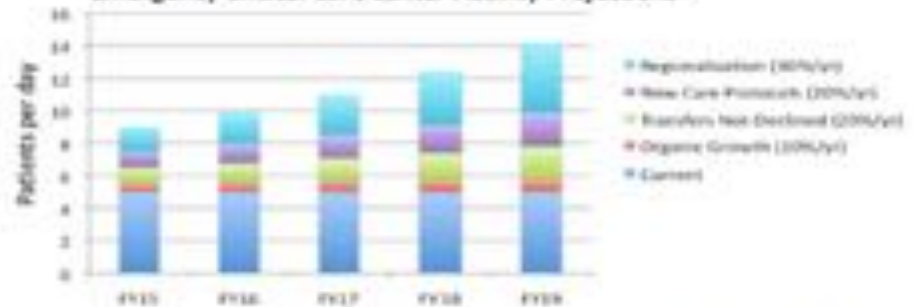
Create the infrastructure and systems necessary to provide time sensitive diagnosis, treatment and monitoring of critically ill and injured patients presenting to UH Adult ED.

- EM Division of Critical Care, Division Chief, and EC3 Medical Director
- Establish an ED Critical Care Center by renovation of 6000 sq. ft. currently occupied by ED Resuscitation, ED North (old CES)
- 24/7 EC3 attending staffing: EM Faculty with EM/CC board certification or additional training/credentialing. Staffing will require 7 full-time faculty
- ED Critical Care Nursing Services / Nurse Internship
- Shared ED Critical Care fellowship programs (Pulmonary/Critical Care and Anesthesiology/Critical Care)

EC3 Capacity Assumptions:

- Max patients per day = 15. 15x 365 = 5475 pt/yr. LOS ~12 hours. Beds=9
- Forecast EC3 patients: Current activity = 1896 pt/yr. (31% occ) 5 yr goal = 3130 (93% occ).
- Impact on inpatient capacity mitigated by initiatives to develop alternatives to admission for general ED patients

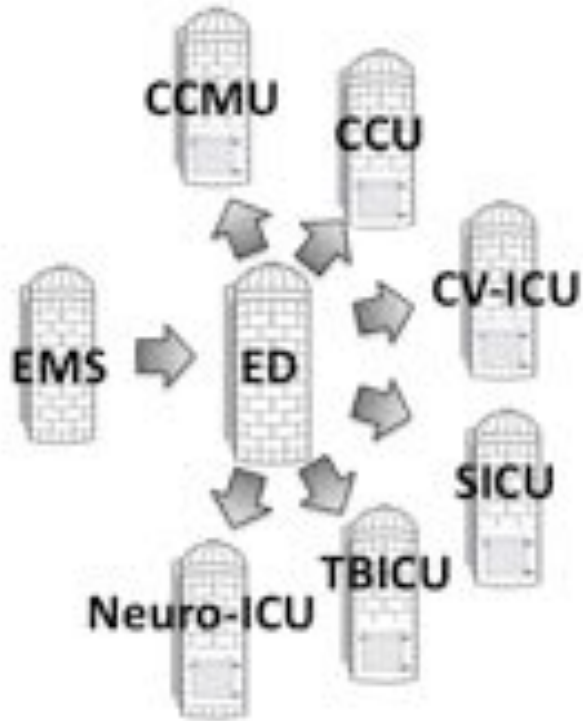
Emergency Critical Care center Activity Projections



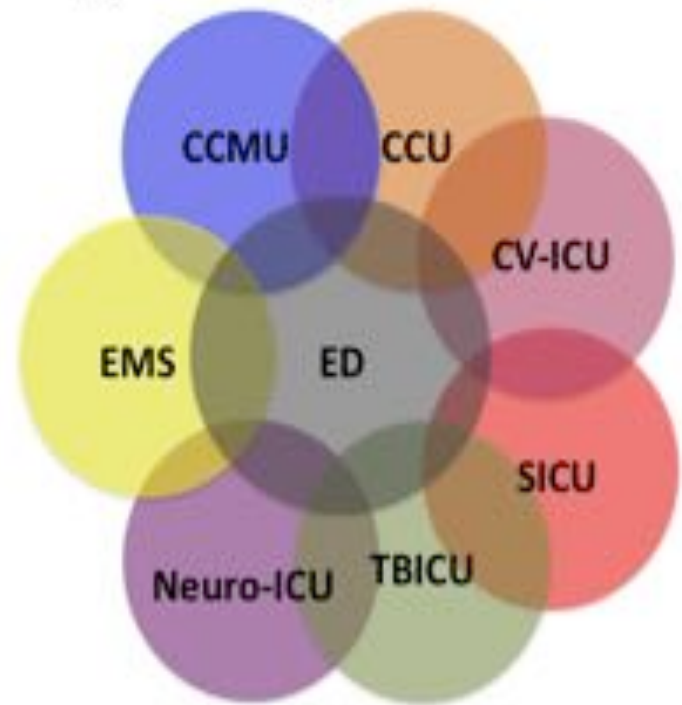
Project Cost : \$7 mil (\$3.5 construction, \$3.5 capital equipment)
 NPV range: \$9 to \$3 mil (calculated on incremental activity only)

Paradigm Shift

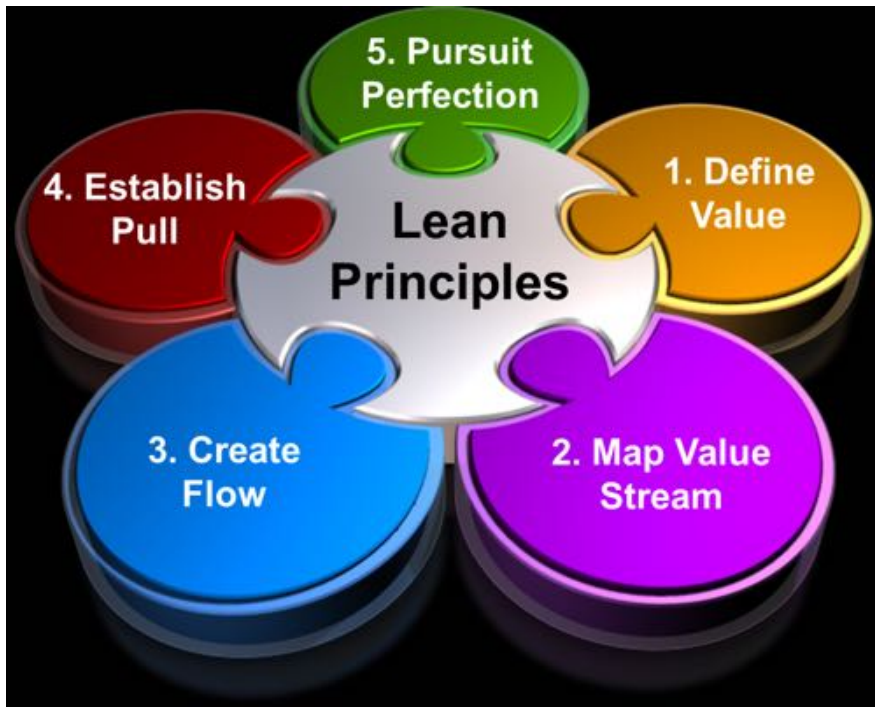
Gated Silos of Emergency Critical Care



Integrated Emergency Critical Care



Apply LEAN principles to problem identification and solution



Lean Facility Design

- Engage frontline workers to create optimal workflows and eliminate waste
- Architects and designers transform process maps into a design
- Focus on removing physical barriers from the workflows
- Paradigm shift of architects from project leads to team member and facilitators

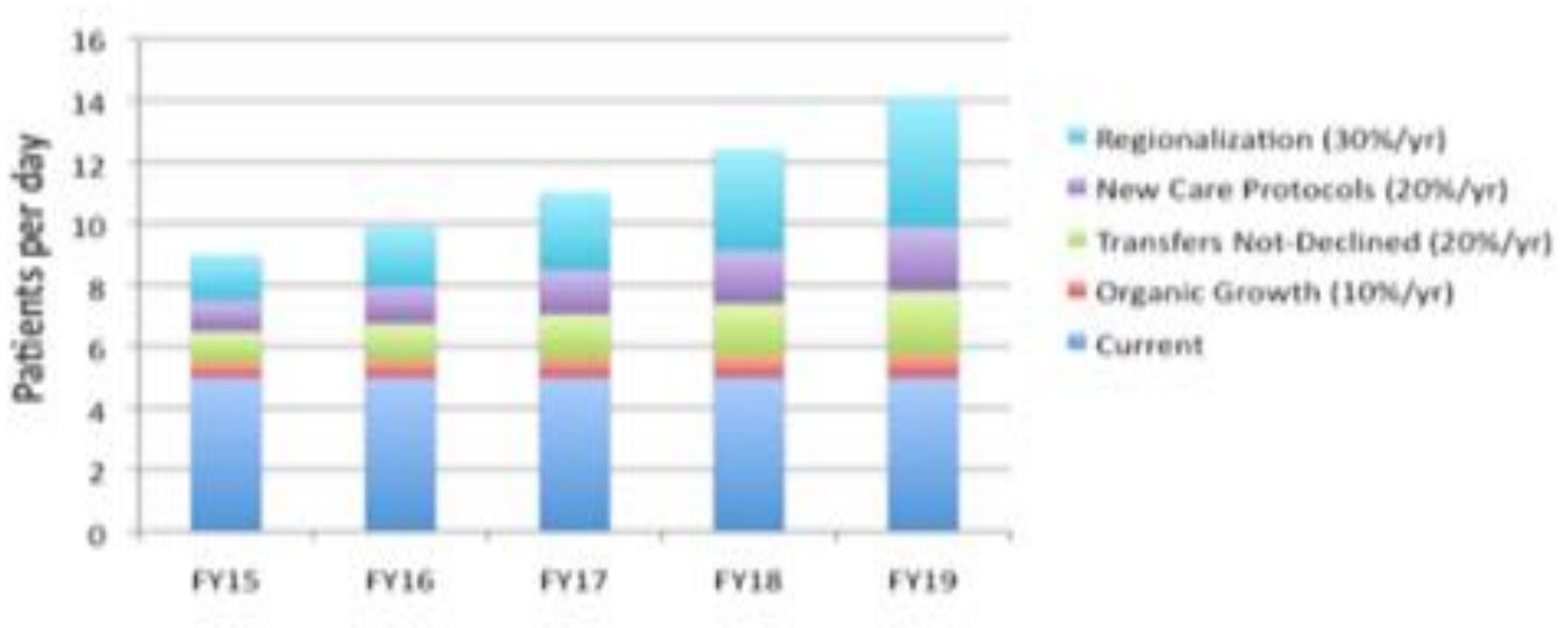
Lean Patient Flow Transformation

- Purpose – fix patients' problems definitively
- Process – fundamentally redesign the processes (not just tightening up the old way)
- People – a true multidisciplinary team

Queueing Model

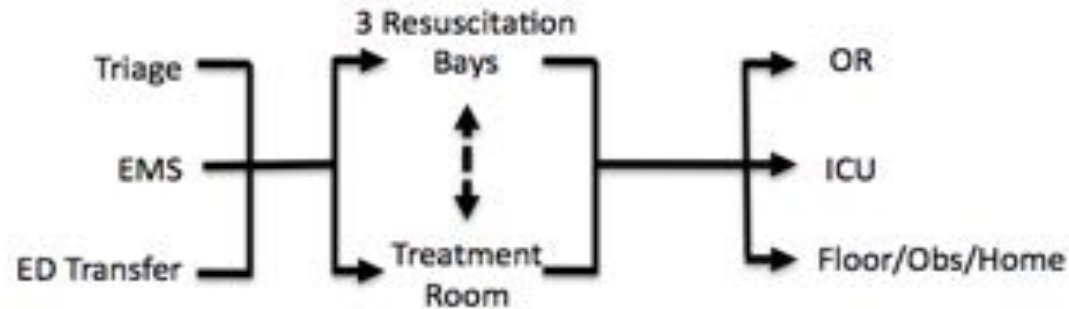
- Assumptions:
 - Current volume
 - EC3 LOS – 12 hrs
 - 50% of patients treated in resuscitation bays would pass through EC3
 - 10-20% of patients would no longer need ICU
- **Model Output:**
 - **Require 5 resuscitation bays and 7 EC3 rooms**

Growth Projection

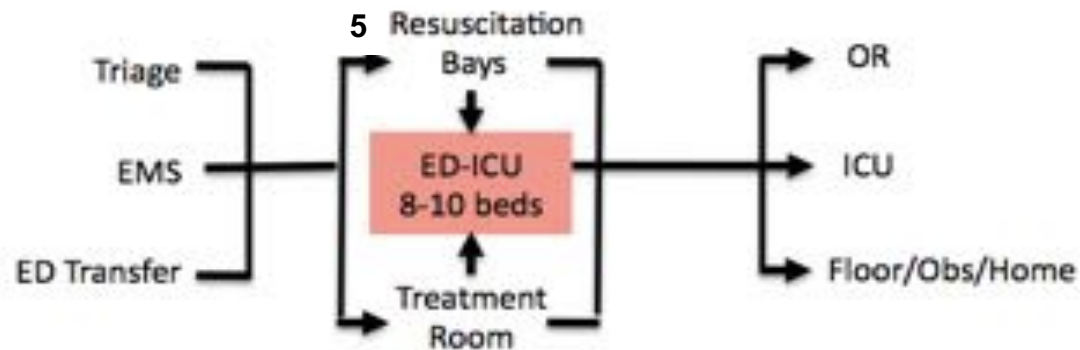


Proposed Future State

Current State



Proposed Future State



Creating a Multidisciplinary Team



Many team meetings 2 years prior



Key LEAN Tools

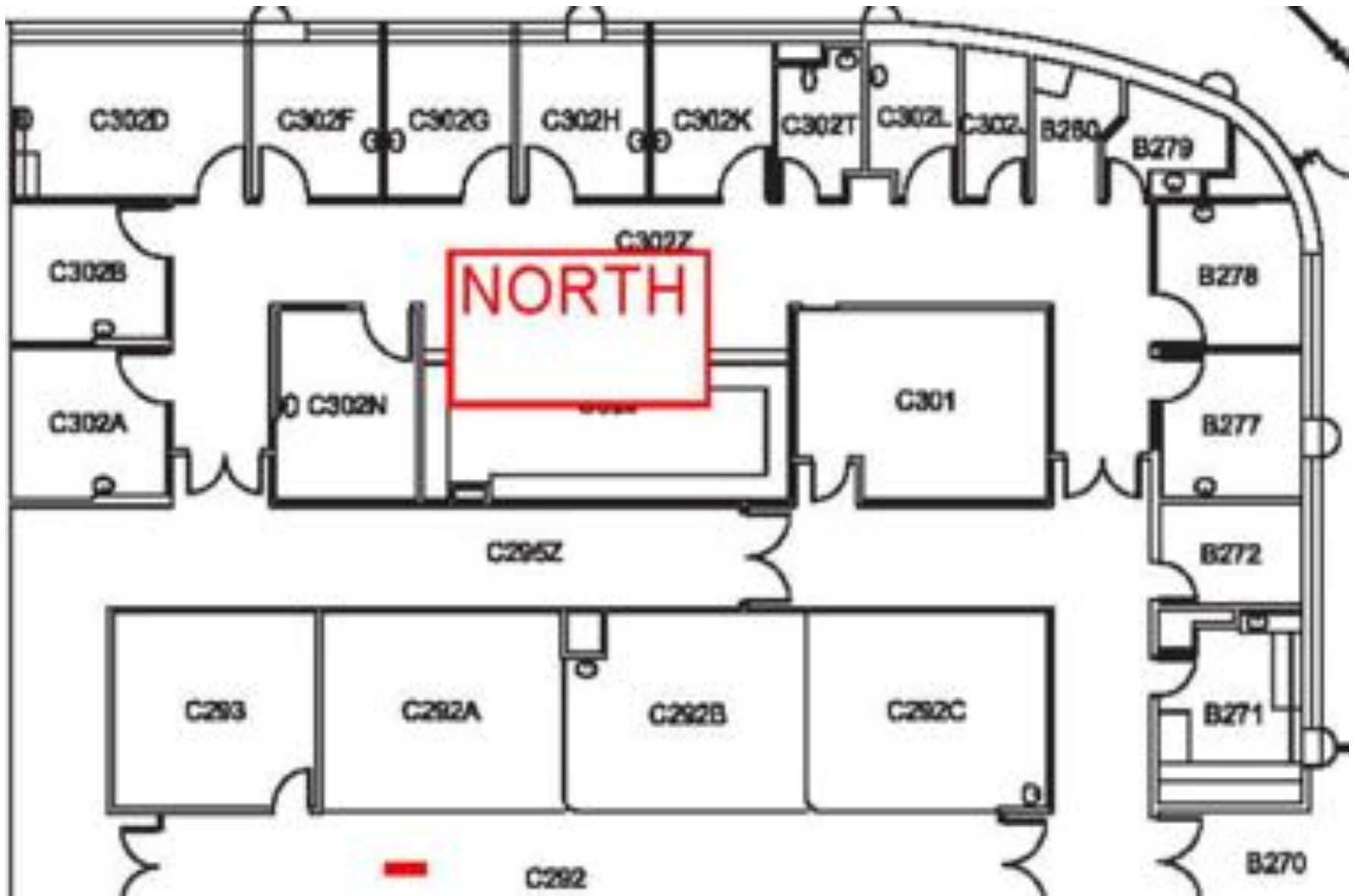
- A3 Thinking
- Go and See
- Rapid Improvement Events (Kaizen)

Roadtrips



SCHEMATIC DESIGN





EC3 v1.0



Full Scale Mock-up



Utilize Actual Equipment



Multidisciplinary Teams



Multidisciplinary Teams



Egress



Immovable Barriers



Idea Boards



Idea Boards

COMMENTS

3 Designate a space by MOB for RAJ & space for RT on other side

- ~~space for RAJ~~ - ~~space for RAJ~~ - ~~space for RAJ~~
- in room corridor
- Consider date of birth first to make sure room
- Room for medical condition for family
- Making sure no noise in attached floor bathroom
- If it's hard to get through
- Can we have desk

- Try to have family only on one side & All nursing equip/meds on the other

- Drinking fountain for family in unit

- Floor in that looks clean

- Not on ceiling

- Different computer is back up to patient - Also need to clean to door on back end - Try to make it (142)

- Dinner to table for room

* Please consider feedback in
room etc. just

- Let's have the green of the room with another green amount of study
present in RAJ

- Color like in hospital room? -> look to see a job what about all rooms?

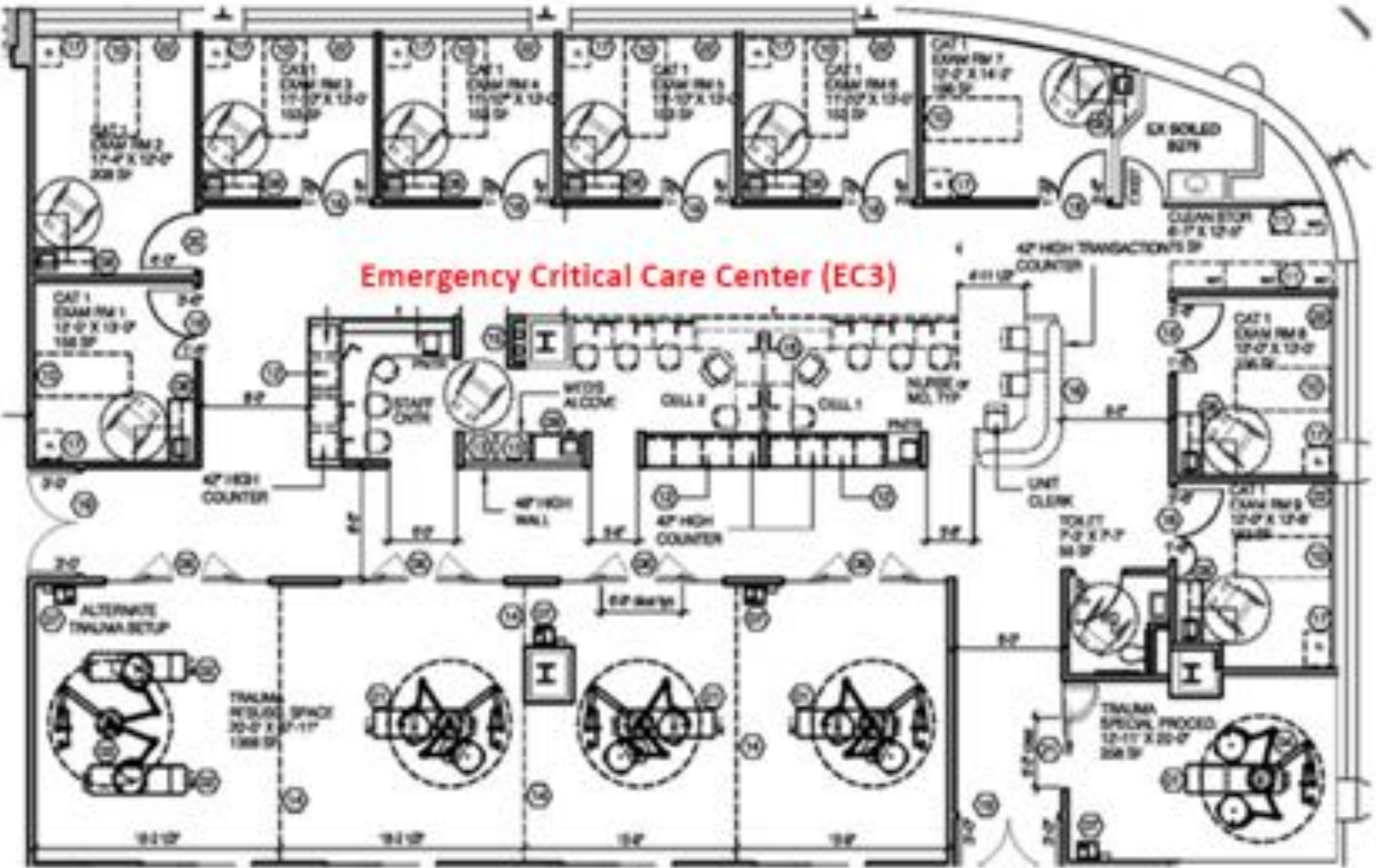
- Keeping @ pressure rooms

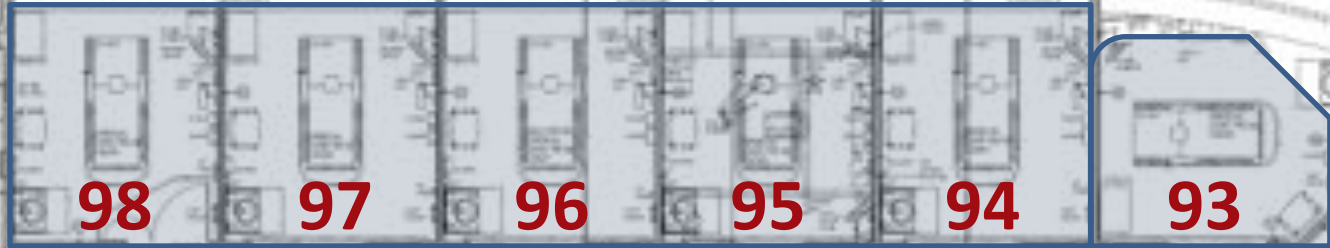
- Cows in that room please space

- More clean storage for portable monitors, etc. in room

Mock up Lessons Learned

- This is a really good idea
- No precedent at MM
- Empowering/Inclusive/Unifying
- Significant design changes BEFORE construction
 - No significant change orders
 - Under budget
 - Ahead of schedule





Emergency Critical Care Center (EC3) (91-99)



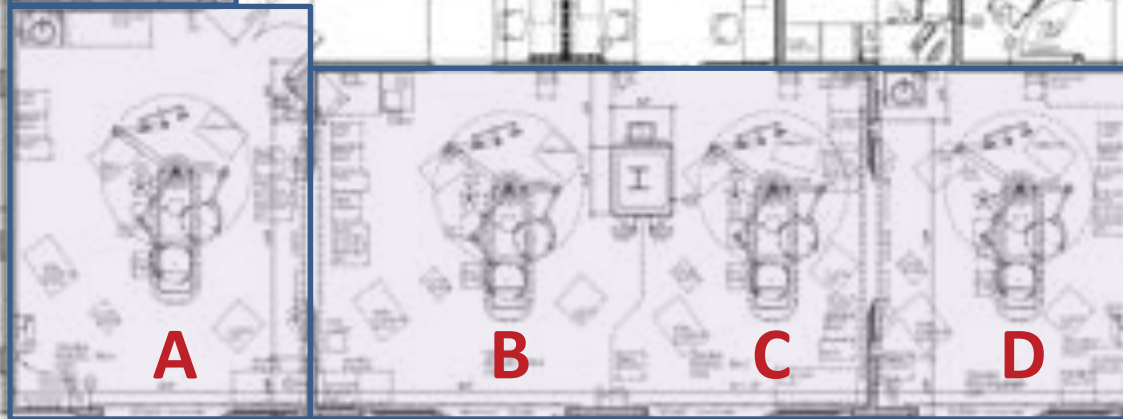
99



92



91



A

B

C

D

ED Resuscitation Bays (A-E)



E

**Ambulance
Entrance**

Bring in the Muscle...

September 2014





STOP
DO NOT ENTER

WARNING: FIRE & PROTECTIVE EQUIPMENT ROOMS ARE NOT TO BE ENTERED WITHOUT PERMISSION



Implementation Plan





Background (Why is this important?)

- Critical illness and injury, when considered as a single entity, is the leading cause of death in the United States.
- The national burden of critical illness and injury presenting to Emergency Departments is increasing at an alarming rate.
- This growth is expected to continue due to an aging population with increased comorbidities and complications of advanced medicine.
- The effectiveness of critical care for acute illness and injury is time-sensitive with therapeutic windows ranging from minutes to hours.
- Execution of the UMMS Strategic Plan to **improve and high complexity medical care** (from 10% to 15%) will amplify the demand for emergency critical care in our system.
- The emergency care system, in its current structure, is not prepared to respond to these challenges.

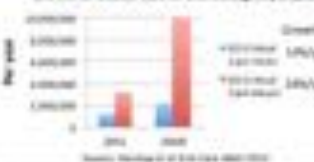
Causes of Death in the United States¹



Therapeutic Windows



Breakdown of Critical Care in U.S. Emergency Dept.



Analysis (What are the root causes of the problem?)

- Critical Care developed as a subspecialty within many different medical disciplines. Most specialties have created a dedicated space to provide critical care that addresses the specific needs of their specialty. As a result, the practice of critical care is significantly siloed.
- Emergency Critical Care (ECC) critical care is emerging as a distinct subspecialty of Emergency Medicine. This is driven by the expanding demand for critical care services in the ED setting, and advances in time-sensitive diagnostic, therapeutic and monitoring. New pathways have been established for ED residents trained physicians to become eligible for critical care board certification through fellowship training in Fellowship/Fellowship of Care, Surgery, and Interventional Pathways. This development provides a unique opportunity to integrate critical care within the faculty systems. However, as with other specialties, a dedicated space is needed to deliver critical care in ED setting.
- ED physical plant: In the UM Adult ED, the delivery of critical care is physically dispersed and problematic rooms with inadequate space and equipment. Creation of an ECC critical care center (ECC) will directly address this issue. Costing analysis assuming current volume, ED/ICU 1:1, and ECC utilization by 50% of ED patients initially. Invested in resuscitation team require 3 resuscitation bays and 7 ECC Bays.
- ED staffing model: The initial diagnostic workup, treatment, and monitoring of ED critical care patients is resource intensive with high risk for errors of omission and commission. Outside the 1-resuscitation bay in the UM Adult ED, critical care is currently provided at a 1:1 patient care ratio and at 1:1 patient attending ratio. Provider staffing in an ECC would be better suited to the level and intensity of care provided.
- Critical Care Pathway: Continuity and consistency of care for critically ill and injured ED patients is limited due to lack of agreed upon patient care pathways. A Critical Care Pathway Group was established in November 2012 to develop multidisciplinary treatment pathways for critically ill and injured patients presenting to the UM Adult ED. The group includes medical directors and nursing representatives from ED, CCU/ICU, OCU, ICU, TMSU, NICU, OCU/ICU. Current pathways in use include Post-Cardiac Arrest, Septic, GI Bleed, SSI, Respiratory Failure, DKA, Status Epilepticus.

Current Situation (Where are we now?)

- UM Adult ED volume is 77,000 ED patients admitted to ED, 5.2 patients per minute at average rate of 9 hours. Providing 10% annual growth.
- UM Medical Floor 2 resuscitation bays not activated in July 2013. Insufficient to meet current and forecasted demand.
- UM Staffing: 32 patients - average ratio for 3 resuscitation bays 1:1 for resuscitation of ED. 581 patients in attending ratio for total ED including 1 resuscitation bay.
- Staff/room volume of ED critical care believed to have critical care area where patients are resuscitated to resuscitation bay.
- ICU/ICU admitted to ED without access to a resuscitation bay.
- ED transfer location - 100% ED/ICU transfer to ED admitted.
- ED ED admissions with ED ED/ICU 24 hrs - 1400/y.
- ED floor admissions transfer to ED/ICU 24 hrs - 2000/y.
- ED critical care delivery negatively impacts throughput, quality and safety for general ED patient population in current structure.
- Coordination of patient care between ED and ICU is suboptimal which impacts quality and safety.

ED/ICU Admissions from UMMS Adult ED



UMMS ED ratio for emergency resuscitation team services



Emergency Critical Care Center



Future State (What are the proposed countermeasures?)

- Create the infrastructure and systems necessary to provide time sensitive diagnosis, treatment and monitoring of critically ill and injured patients presenting to UM Adult ED.
- EM Division of Critical Care, Division Chief, and ECC Medical Director.
- Establish an ECC Critical Care Center by renovation of 8000 sq. ft. currently occupied by ED Resuscitation, ED North and ICU.
- UMMS ECC attending staffing: 18M weekly with 18M/10 board certification or equivalent training/credentialing. Staffing will require 7.5M 24-hour weekly.
- ECC Critical Care Nursing Services / Nurse Internship.
- Shared ED Critical Care Fellowship programs (Pathway/UM Critical Care and ECC University Fellowship).
- Max patients per day with 100 beds + 1400 y/y, 100-150 beds, 100-150 beds.
- Forecast ECC patients: Current activity + 6000 y/y, 2000 bed + 1000 y/y, 1000 y/y.
- Impact on hospital capacity mitigated by initiatives to develop alternatives to admission for general ED patients.

Emergency Critical Care center Activity Projections



Project Cost: 10' mil (\$2.5 construction, \$7.5 capital equipment) MPE range: 100 to 150 (contingent on incremental activity only)

Goal (Where do we want to be?)

- Support UMMS Strategic Plan
- Establish multidisciplinary patient care protocols for critical care that ensure seamless transition from ED to hospital inpatient and beyond.
- Enhance the capacity and capability to deliver high quality emergency critical care by creating a dedicated Emergency Critical Care Center in the UM Adult ED.
 - Improve timely access to critical care services
 - Improve outcomes (Survival, ICU LOS, Resuscitation)
 - Reduce medical errors
 - Reduce short stay ECC admissions
 - Reduce floor-to-ED transfers by 50-75%
- Expand clinical research initiatives in critical care to synergize with the newly established ED ICU.
- Establish EM critical care training capacity including and UM approved fellowships.
- Facilitate collaboration with inpatient critical care providers in areas of patient care, education and research.
- UMMS established as Center of Excellence for regionalized emergency critical care.



Implementation Plan (What activities will be required and who will be responsible for what and when?)

- Develop a complete strategic planning.
- Develop Division of Emergency Critical Care in the Dept. of Emergency Medicine
- Recruit Medical Chief and Academic in Emergency Medicine and Critical Care
- Recruit scope of practice for ED critical care services in the ED
- Staffing model for nursing, physician, medical assistant.
- Develop patient care protocols for Emergency Critical Care
- Support research in resuscitation, flow, training for ED critical care nursing and medicine (clinical and simulation).
- Recruit nursing/credentialing staff for ED faculty/fellowship/nursing.
- Develop simulation research agenda.
- ED conference center, study and facility.
- Staff nurse/resuscitation center: 100 and 100.
- Medical design plan.
- Physis inventory, equipment, IT requirements.
- Get projected date to become operational.



Outcome Measures

- Improved intermediate and long-term outcomes including hospital mortality.
- Improved adherence to patient care protocols/pathways for critical illness and injury.
- Improved adherence with ECC bundles throughout patient's hospital course.
- Reduced ED LOS for 1 day for patients admitted from ED.
- Reduced floor to ED transfers within 24 hours of ED admission.
- Reduced ED admissions from ED that are transferred to floor inpatient.
- 50-75% of patients treated in ECC admitted to floor instead of ICU.
- Reduced UMMS by creating Adult ED open-air provider capacity.
- Increased critical care clinical trials and educational funding.
- Increased critical care fellowship interest.

1. CDC National Vital Statistics Reports. Vol 36-3 (2011). http://www.cdc.gov/nchs/data/whr/whr36r3.pdf 2. US ED in Brief. Hospital Discharge and Death Statistics, 2011 update a report from the American Heart Association. Circulation. 2013;127:144-149. PMID: 23262873 3. Hering MA et al. Emergency critical care admissions from two Emergency Departments. JGIM. 2009; 24(11):1157-1166. PMID: 19691207

Joyce and Don Massey Family Foundation Emergency Critical Care Center (EC3)

Joyce and Don Massey Family Foundation
Emergency Critical Care Center

Grand opening February 16, 2015



LEAN DESIGN FEATURES

Before – 3 bed Resuscitation Bay



- Cold, CAT scan in zone
- No crowd control
- Patients and families not in ideal environment at their greatest time of need.

Old Resus Bay



Cluttered, old, poorly designed boom systems.

ER flea market with tons of equipment pushed to the back. Can't find anything quickly




A photograph of a modern operating room. In the center is a surgical table covered with a white sheet. Above the table is a large, adjustable surgical light fixture. To the left, a large flat-screen monitor is mounted on the wall. To the right, there are various medical carts, including a red one, and a mobile workstation with a monitor. Three blue callout boxes with white text are overlaid on the image, connected to the scene by thin blue lines. The first box points to the wall monitor, the second to the mobile workstation, and the third to the ceiling-mounted camera system.

Multiple
Video
Displays

Direct Access
to EC3

Cameras for
QA and
Teaching

An operating room with a central table covered in white, surrounded by medical equipment, monitors, and a large overhead light fixture. Two blue callout boxes with white text are overlaid on the image. One box points to a computer monitor on a stand in the background, and the other points to a desk area with multiple monitors in the foreground.

Dedicated
Physician
Order Entry

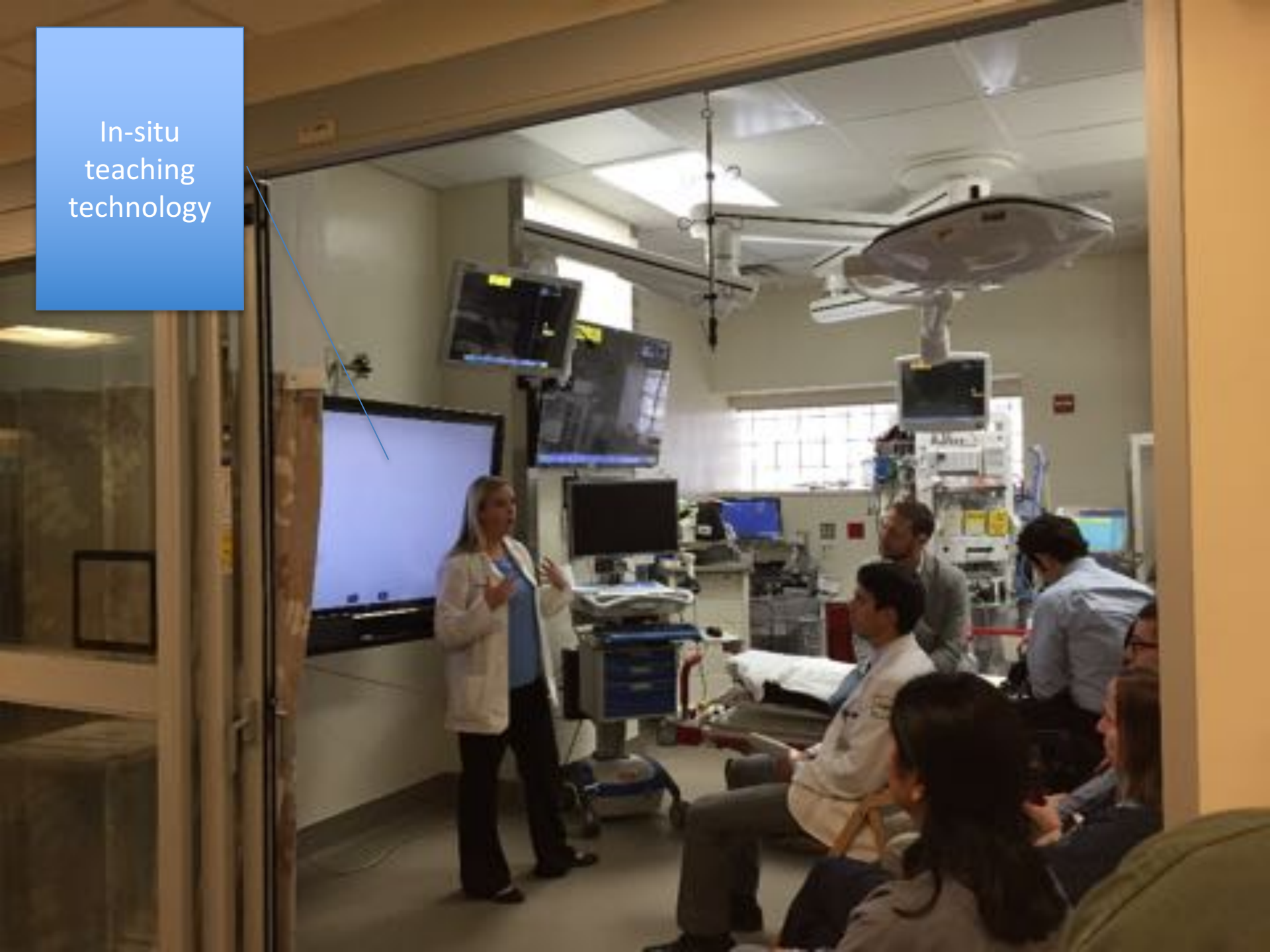
Dedicated
Nurse
Charting
Station

A photograph of an operating room. In the foreground, there is a patient table with a white sheet. Two large surgical lights are suspended from the ceiling. In the background, there are glass-walled rooms and various medical carts. Two blue callout boxes with white text are overlaid on the image. One box points to the ceiling area, and the other points to the glass-walled rooms.

Power, Data
and Gas -
360°

Ability to care for
multiple patients

In-situ
teaching
technology



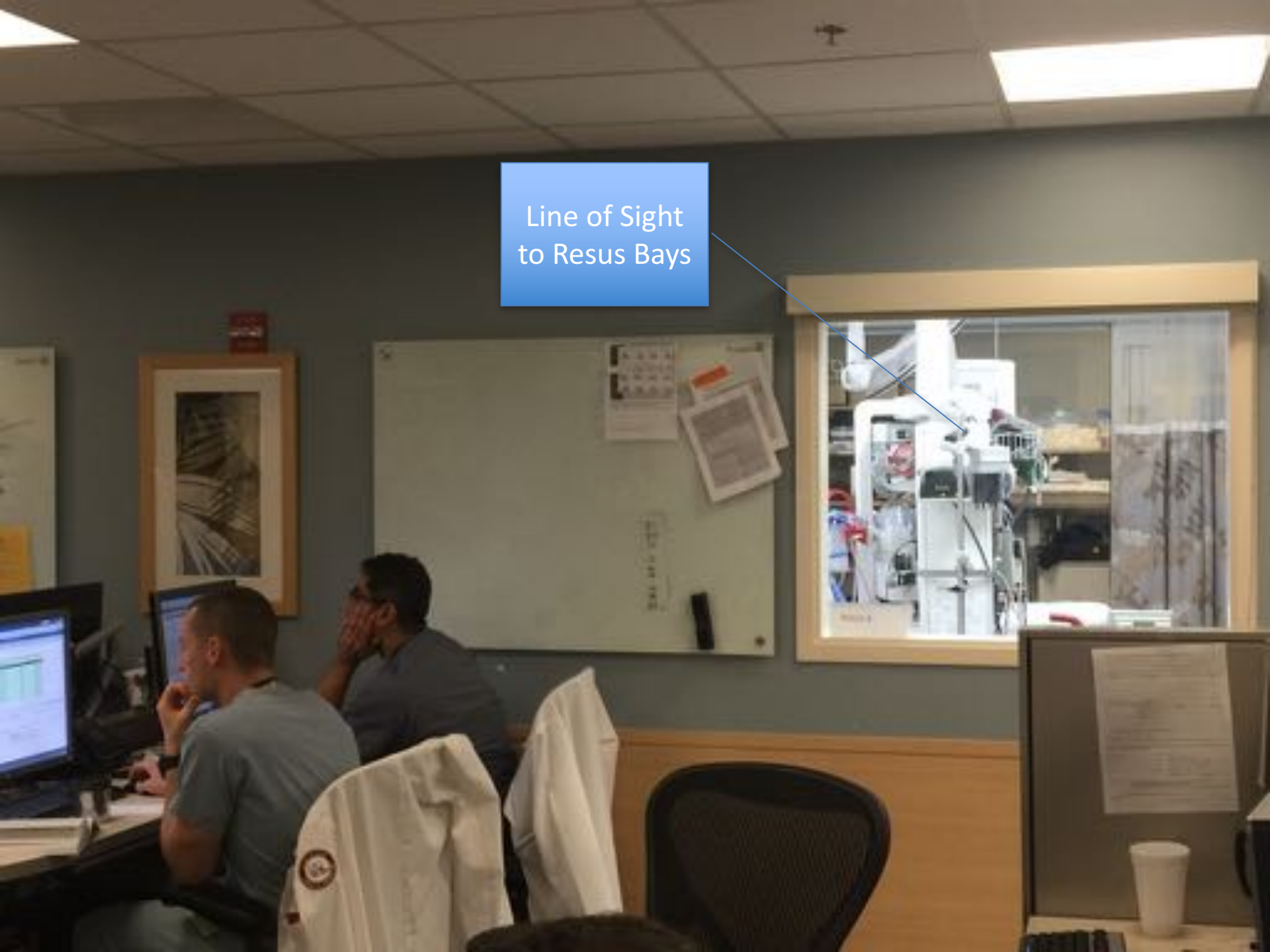
Custom Carts
to Maximize
Space and
Efficiency





Transaction
Height
Counters
Keep Carts
out of
Corridor

Line of Sight
to Resus Bays



Open Line of
Sight Across
Unit





Negative Pressure

Dialysis Boxes

Bariatric Lifts

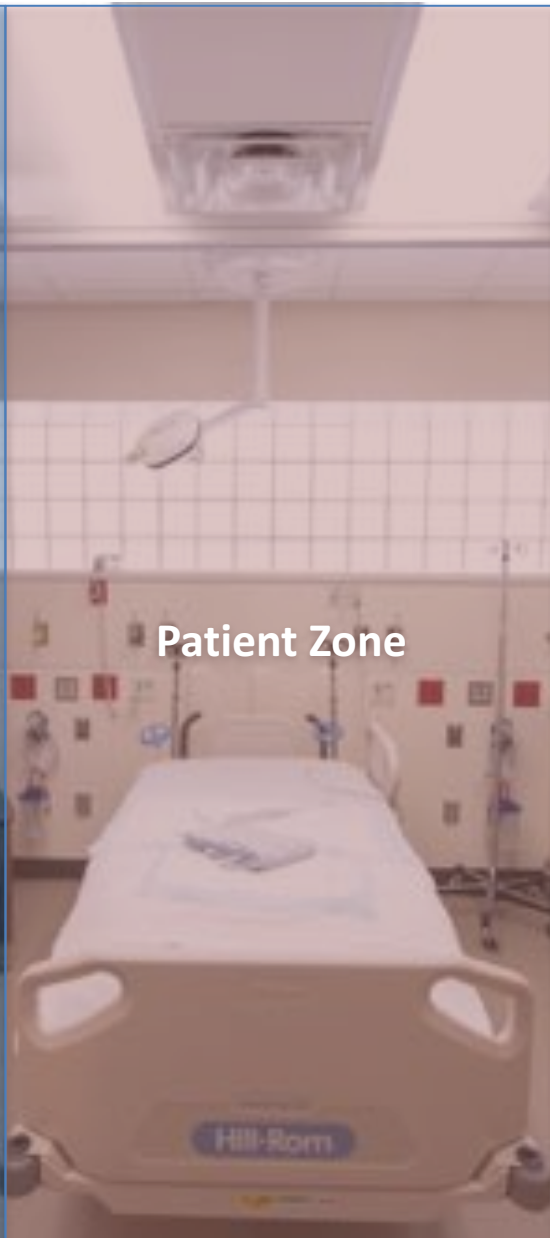
HOB Clear

Ambient Light





Family Zone



Patient Zone



Caregiver Zone

EARLY RESULTS AND TARGET METRICS

Declined ED-ED Transfer Requests (750/yr – 25% ICU)

Declined ED-ED Transfer Requests (597/yr – 9% ICU)

Patient (Home/EMS/OSH)

Increased ICU-ICU Accepted Transfer 32% incr FY16

Shunting of Resources from Non-Critical Patients

14 dedicated beds for CC

Discharge

CC in non-CC area (229/1816 ICU admits – 12%)

CC in non-CC area (450/1886 ICU admits – 24%)

EC3

EC3 – 0 hrs
If no EC3 – 2.5 hrs

CC Boarding (6 hrs)

Floor

9% (460 pts)
CC D/C from ED?

0% change = safe strategy

Emergent Transfer to ICU in < 24 hrs (200/yr)

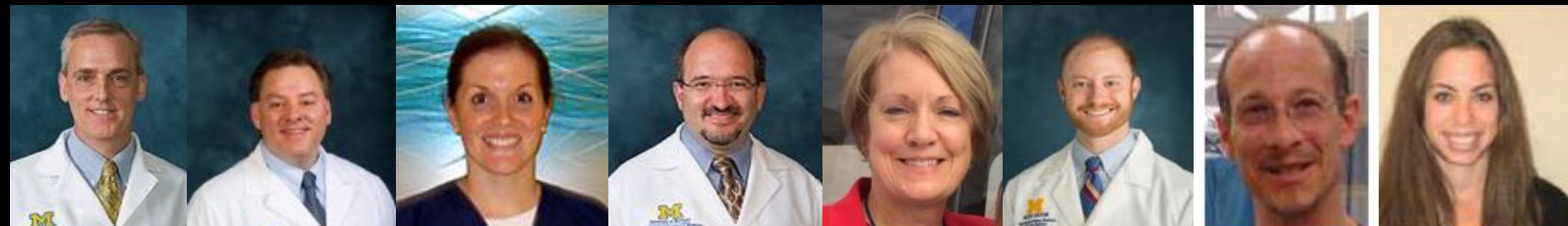
Decreased 43%

Short-Stay ICU Admissions < 24 hr (440/yr)

Summary/Conclusion

- Improve access to timely critical care by enhancing the capacity and capability to deliver high quality critical care in the Adult Emergency Department at the University of Michigan.
- In reality, the model has completely changed the ED & ICU healthcare delivery paradigm

Thank you



Joyce and Don Massey
Family Foundation
Emergency Critical Care Center

Questions?



RAPID IMPROVEMENT EVENTS (KAIZEN)

Excess Equipment



Procedural Line Carts



New Line Cart



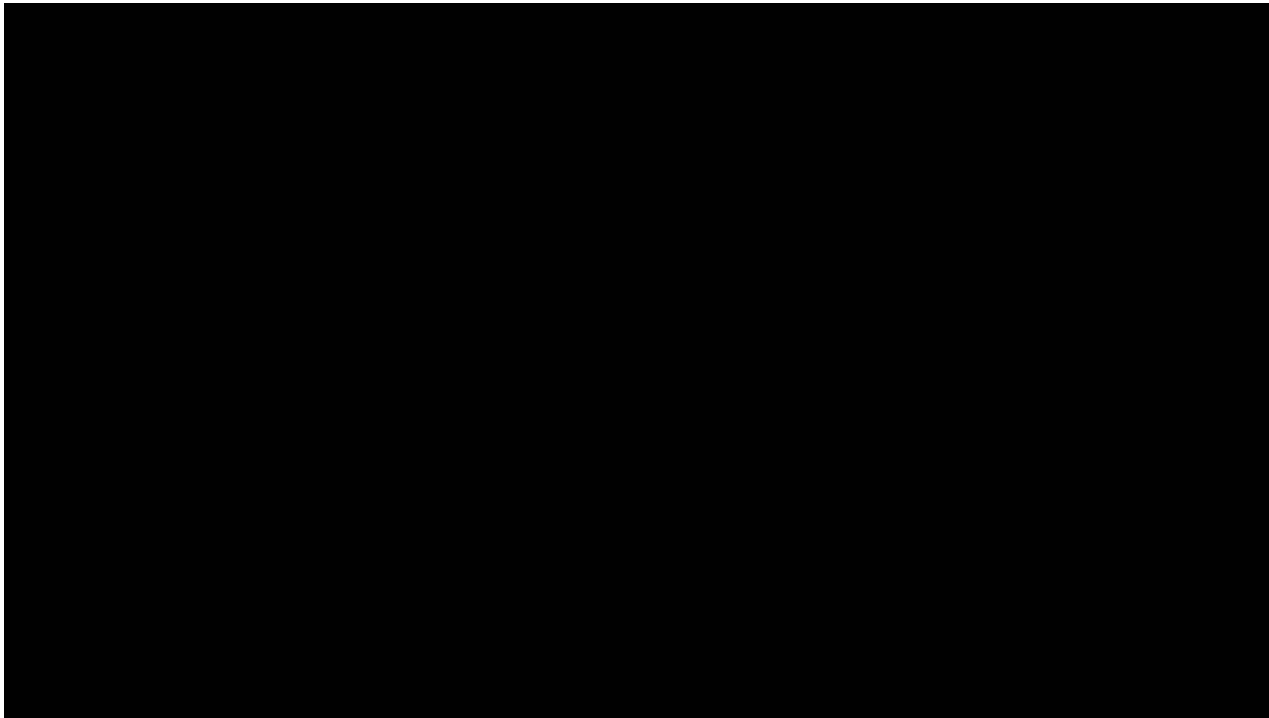
Airway cart redesign



Airway cart redesign

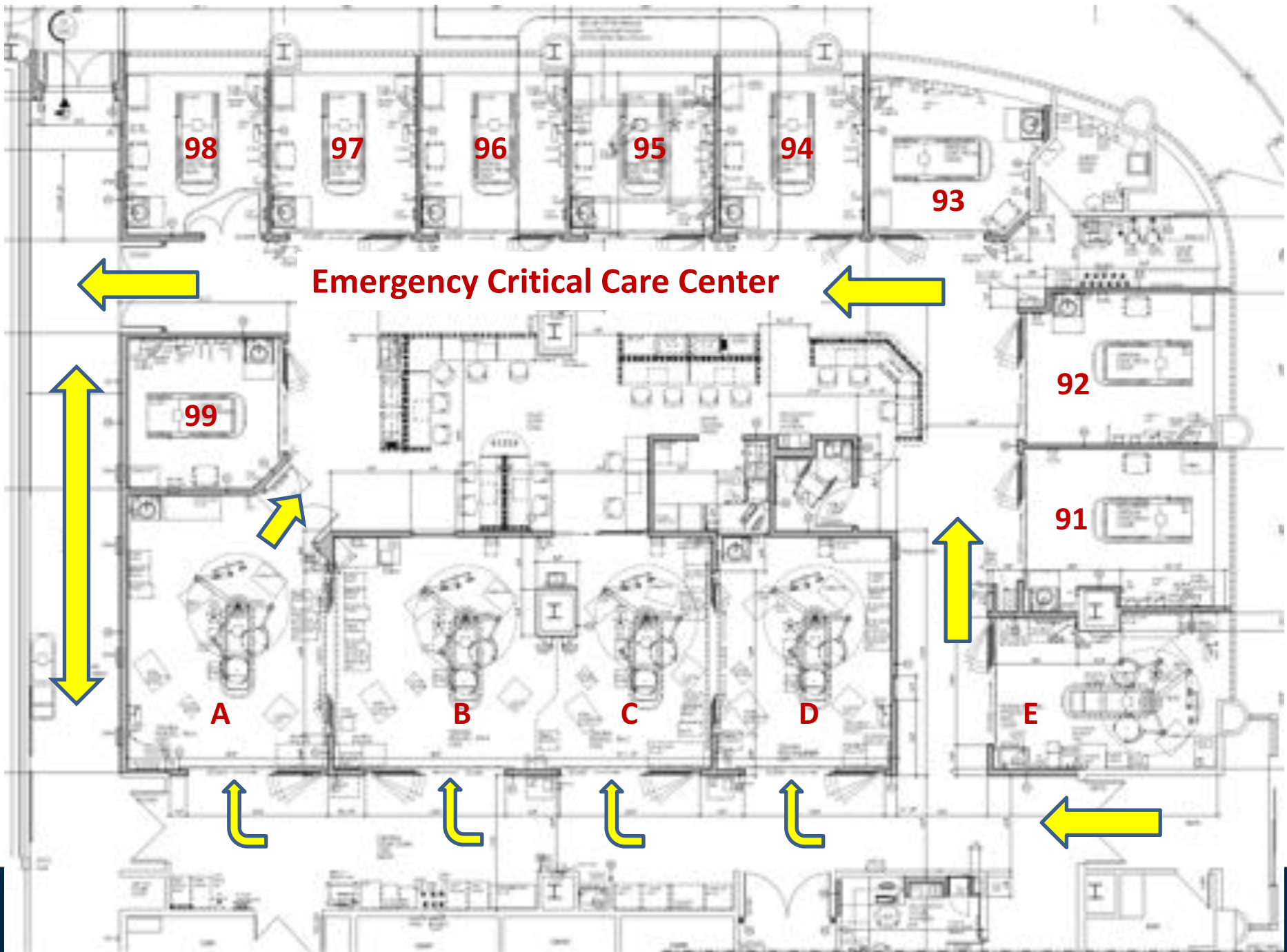


Applied Principles

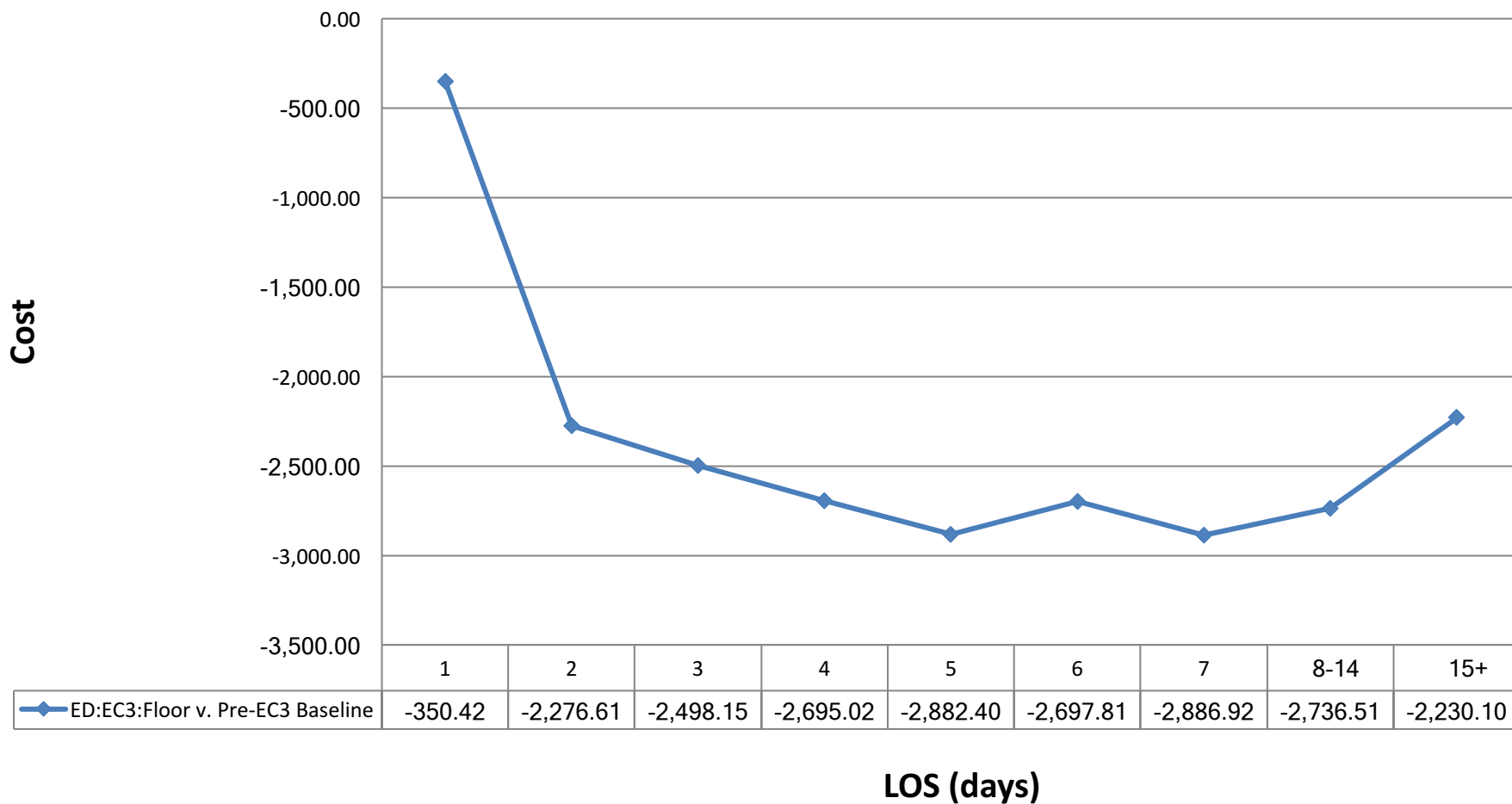


Content Title

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ED:EC3:Floor v. Pre-EC3 Baseline

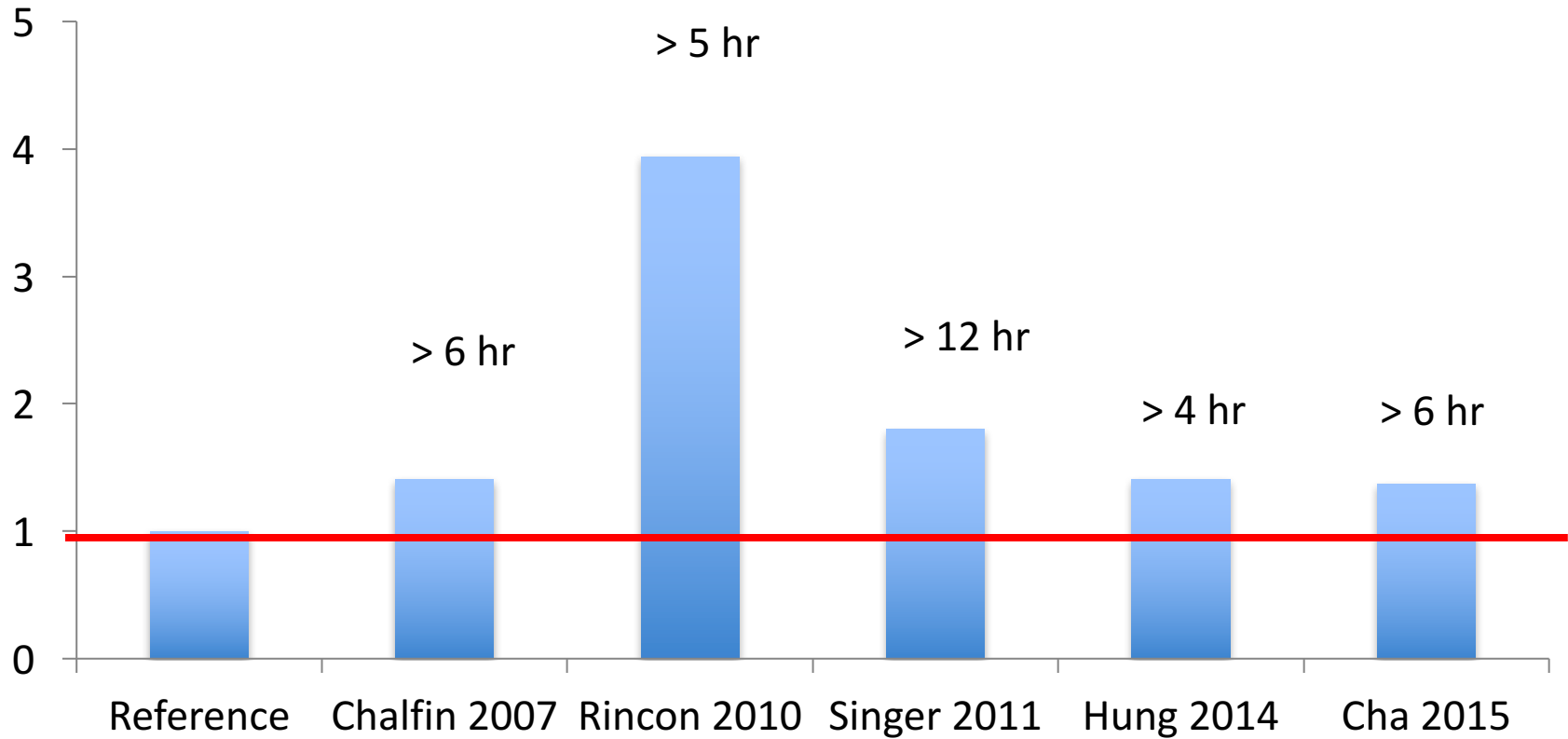


Current State - Adult Emergency Services FY12

- Patient mix Tertiary/quaternary care
- Current volume 67,014/year
- Admit rate 35.4%
- ICU admit rate 10% of admissions
- Transfers from outside ED 3440/year ~300/month
- Transfers declined 750/year (25% ICU level)
- LWBS Rate 3%
- Volume projections 3-4% overall, 10% critical care
- ICU admits w/LOS \leq 24 hrs ~440/yr
- Floor to ICU Txfr \leq 24 hrs ~200/yr

Time in ED waiting for ICU bed...

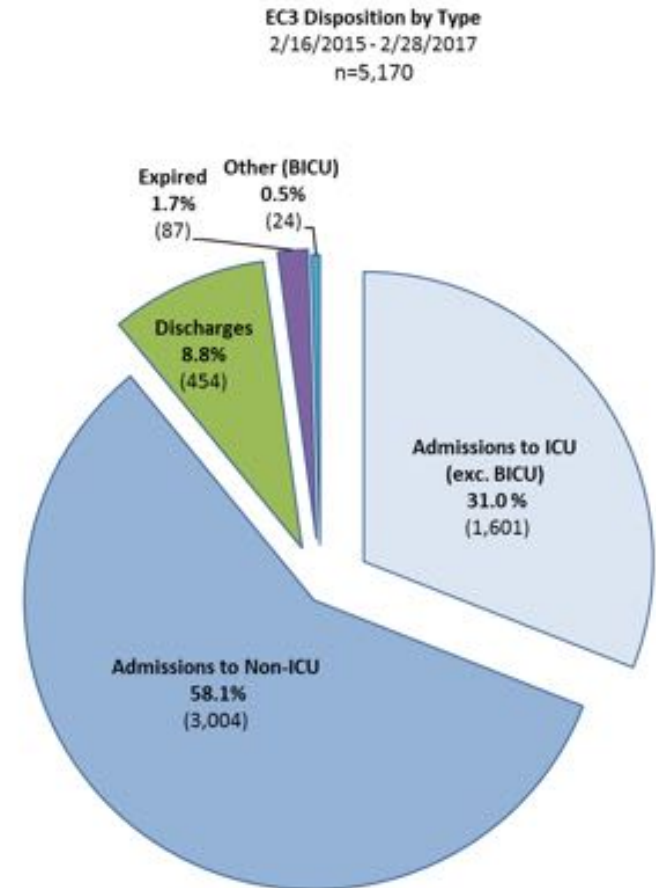
Odds Ratio for death



Results: EC3 Operational Characteristics

- **Average 7 patients per day**
- **Median EC3 LOS ICU admit = 7.2 hr**
- **Median EC3 LOS Non-ICU admit = 12 hr**

EC3 Pathway <i>Multiple per patient possible</i>	Count	%
BiPap/Intubation/Vent	595	11.5%
DKA	276	5.3%
End of Life	61	1.2%
GI Bleed	421	8.1%
Post Cardiac Arrest	84	1.6%
Sepsis	794	15.4%
Shortness of Breath	514	9.9%
Status Epilepticus	57	1.1%
Subarachnoid Hemorrhage	133	2.6%
Undifferentiated	2,546	49.2%
Unknown	391	7.6%



Results: ED Visits and Admissions

	Pre-EC3 (744d)	Post-EC3 (744d)	Relative Change
Overall ED Visits	147,030	157,190	6.9%
Hospital Admissions	51,451	55,912	8.7%
ICU Admissions	3,742	3,279	-12.4%

EC3 Associated with Decreased ICU Admission Rate from ED

	Total ED Visits	ICU Admission	ICU Admission Rate	95% CI
Pre-EC3	147,030	3,742	2.54%	2.4-2.6%
Post-EC3	157,190	3,279	2.08%	2.0-2.2%

Relative Risk Reduction = **18%** [95%CI:11-23%]

Number Needed To Treat = **218** [95%CI:174-361]

EC3 Not Associated with Increased Transfers to ICU within 24 hours of General Ward Admission

	Total Admissions	Transfer to ICU \leq 24 hrs after admit to ward	Rate
Pre-EC3	51,451	377	0.8%
Post-EC3	55,912	400	0.8%

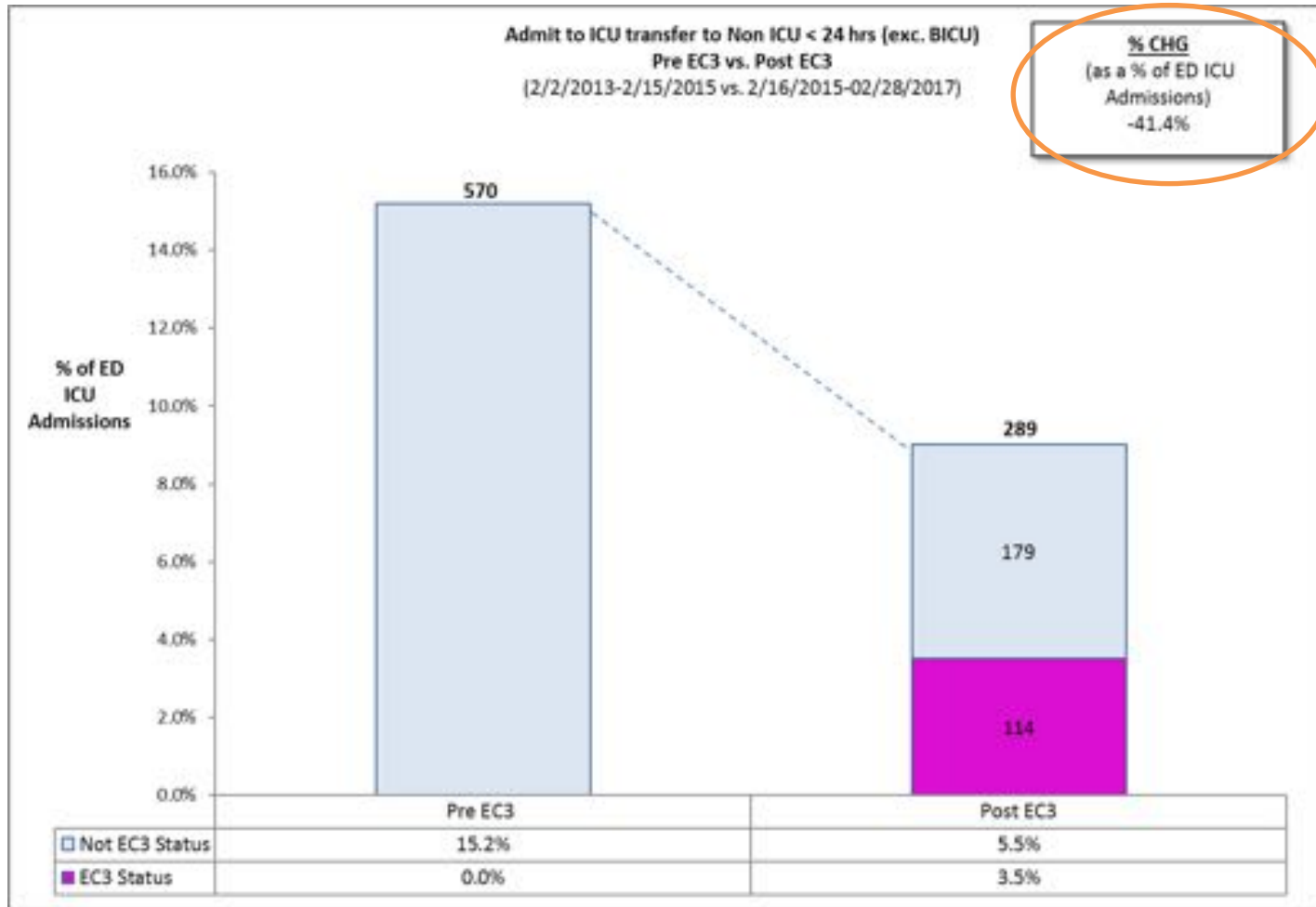
EC3 Not Associated with Increased Short Term (≤ 48 hrs) Mortality

	Total ED Admissions	Death ≤ 48 hrs after admission	Mortality Rate
Pre-EC3	51,451	280	0.54%
Post-EC3	55,912	281	0.50%

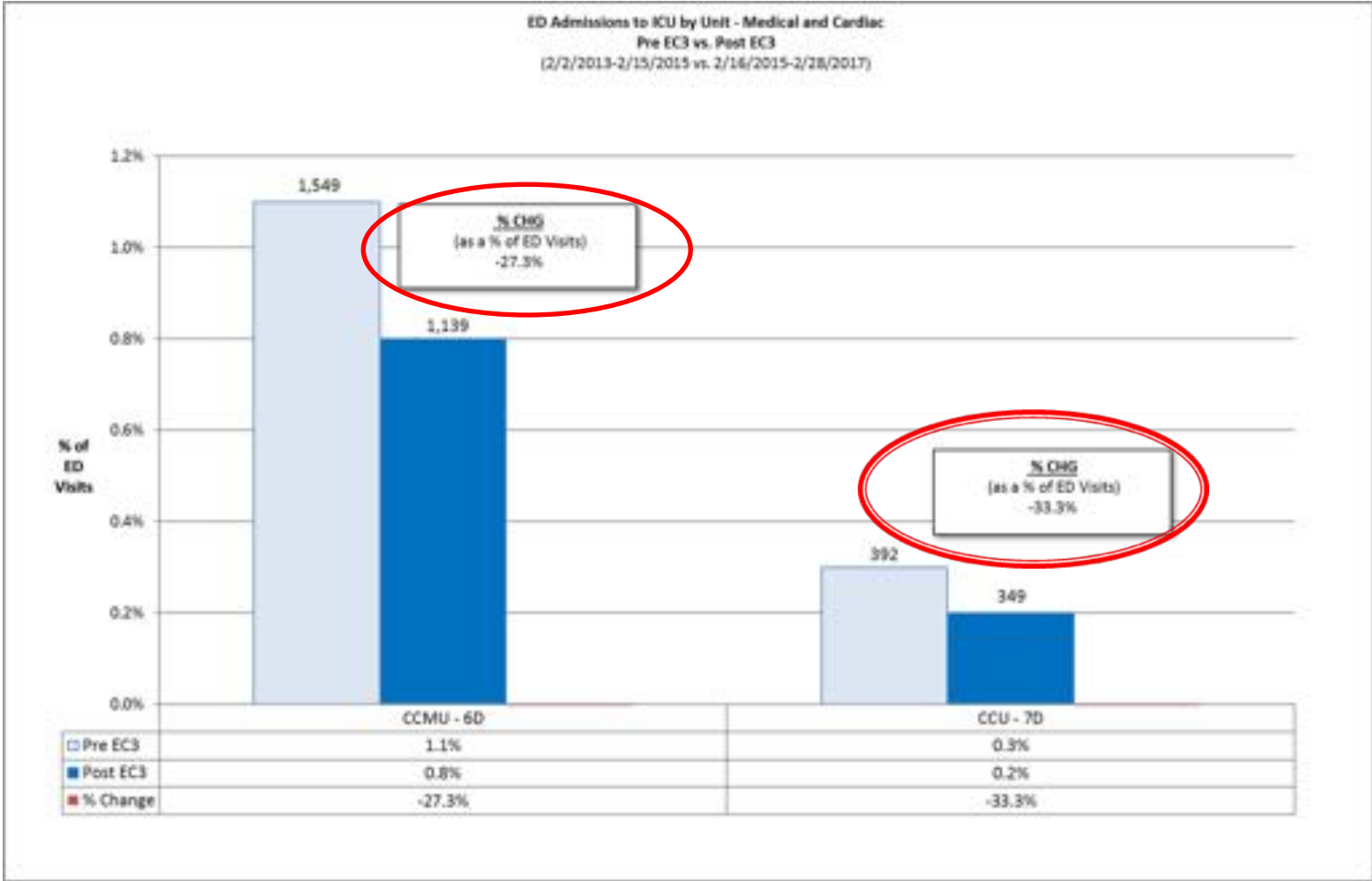
ICU Bed Days Saved

Minimum ICU Bed Days Saved¹	1,188
Average per Month ²	51.4
Average per Day ²	1.7
Median ICU Bed Days Saved	3,326
Average per Month ²	143.3
Average per Day ²	4.7

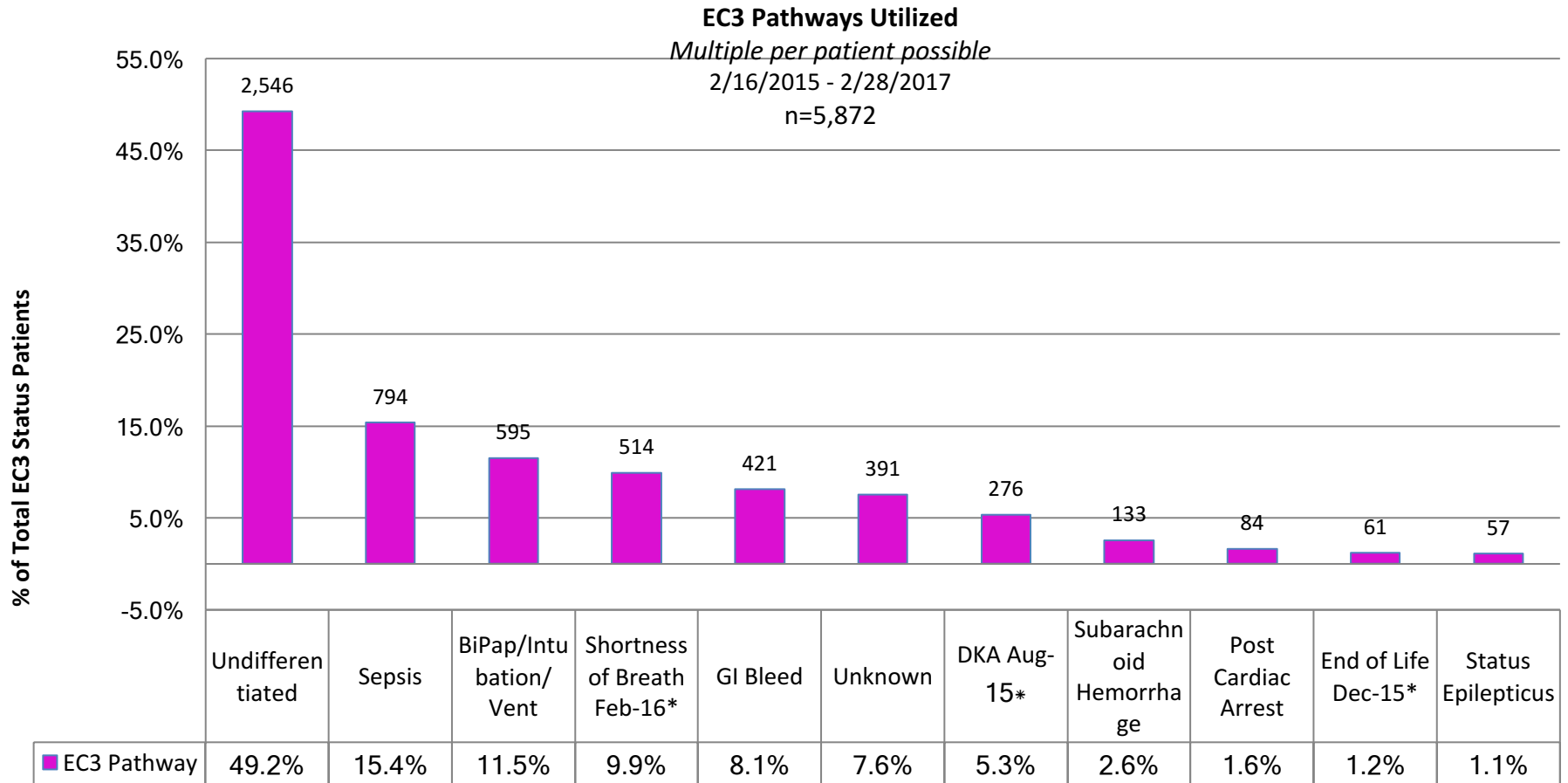
Reduction in “Short Stay” ICU Admissions



Reducing Medical ICU Admissions

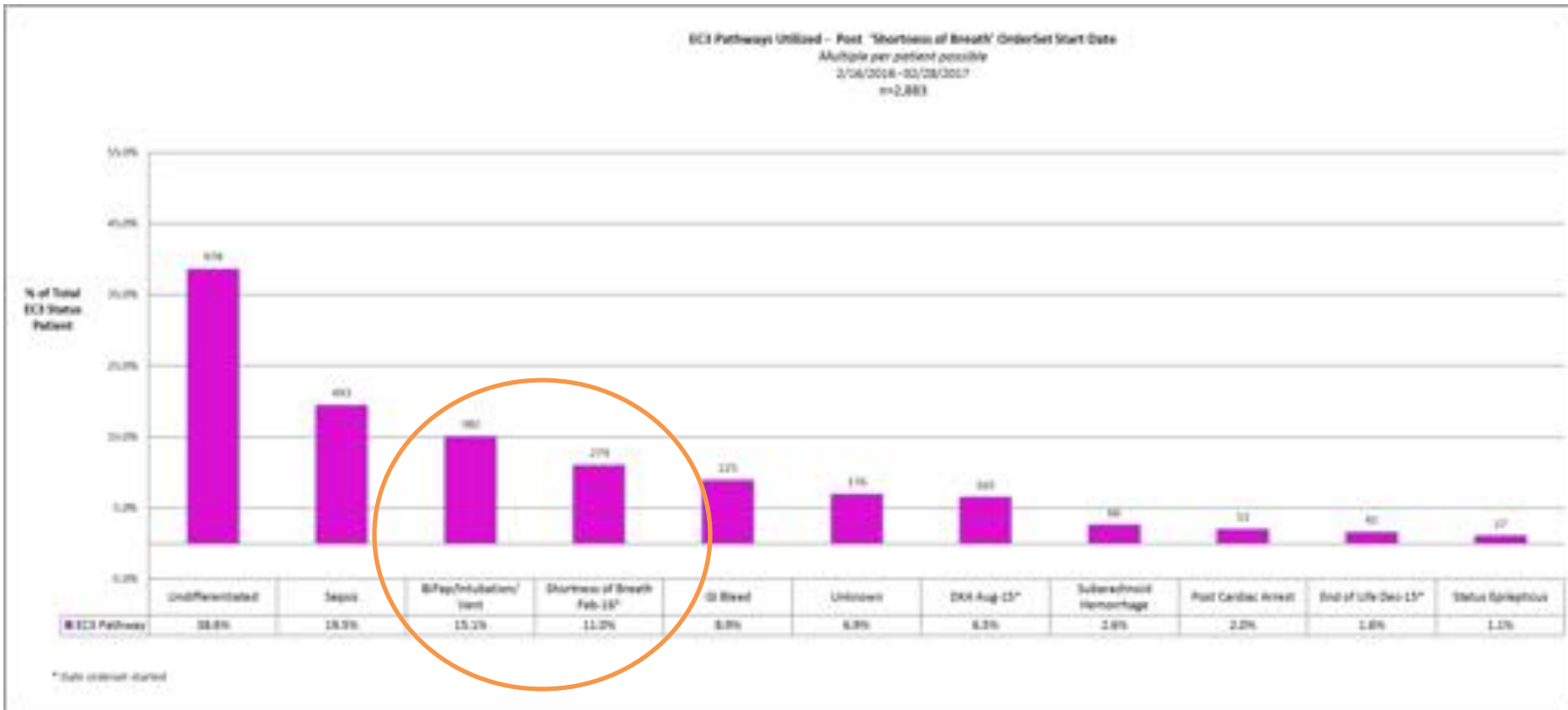


Disease Specific Order Sets

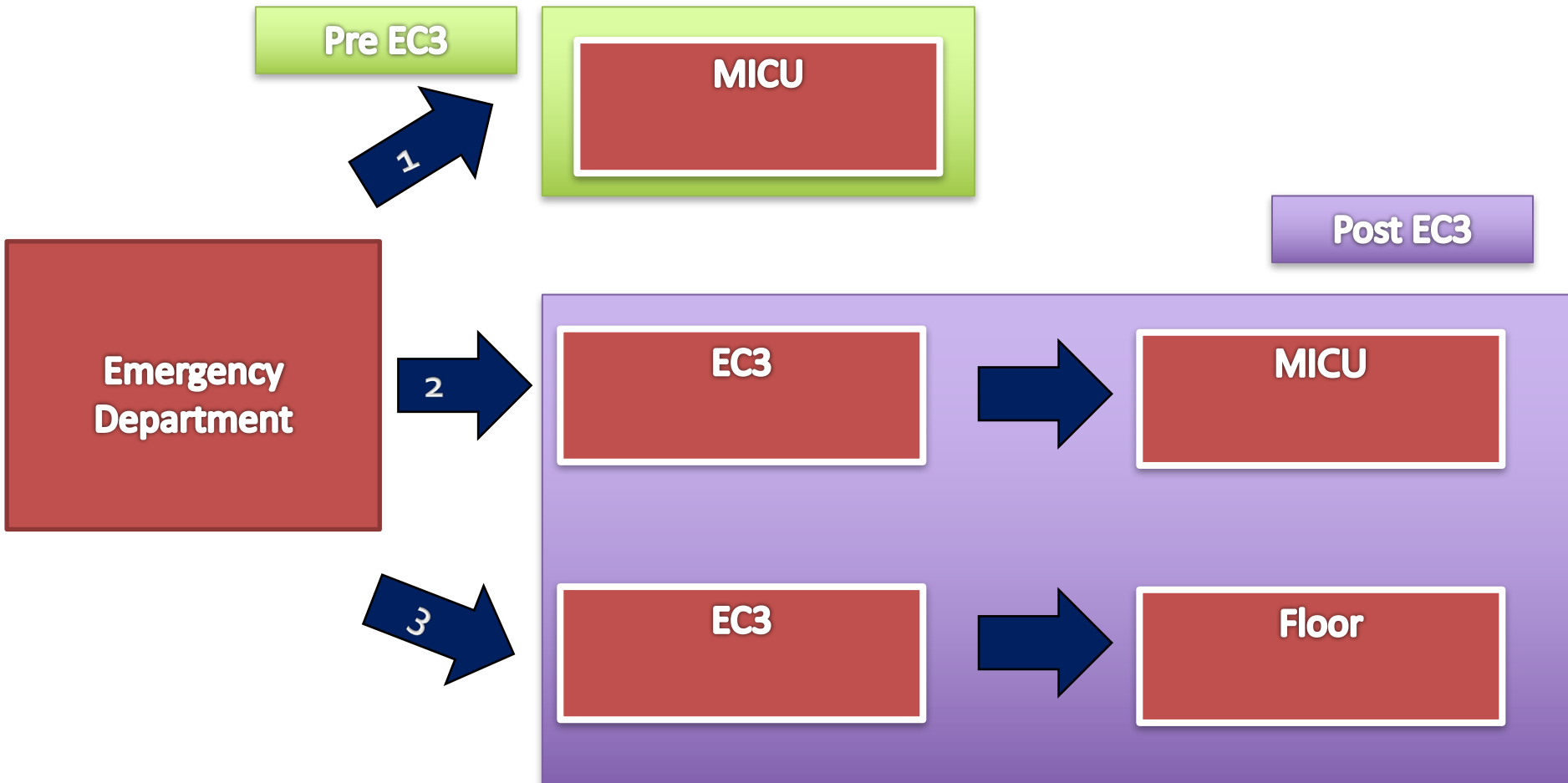


* Date orderset started

Disease Specific Order Sets



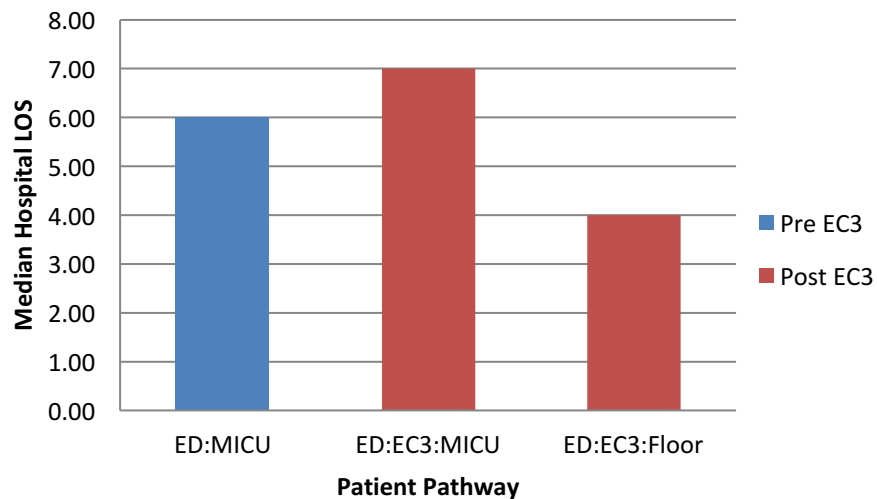
Length of Stay & Cost Analysis



Length of Stay

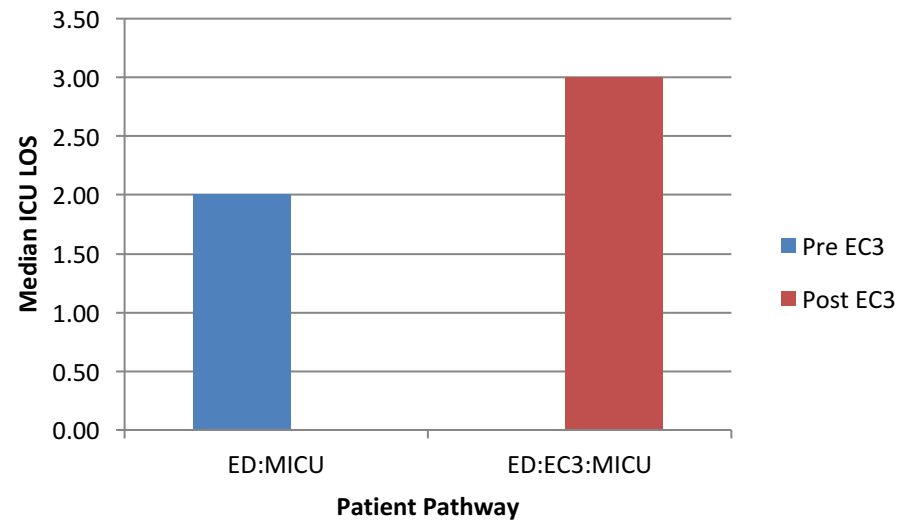
Median Hospital LOS

	Pre EC3	Post EC3
ED to MICU	6.00	
ED to EC3 to MICU		7.00
ED to EC3 to Floor		4.00

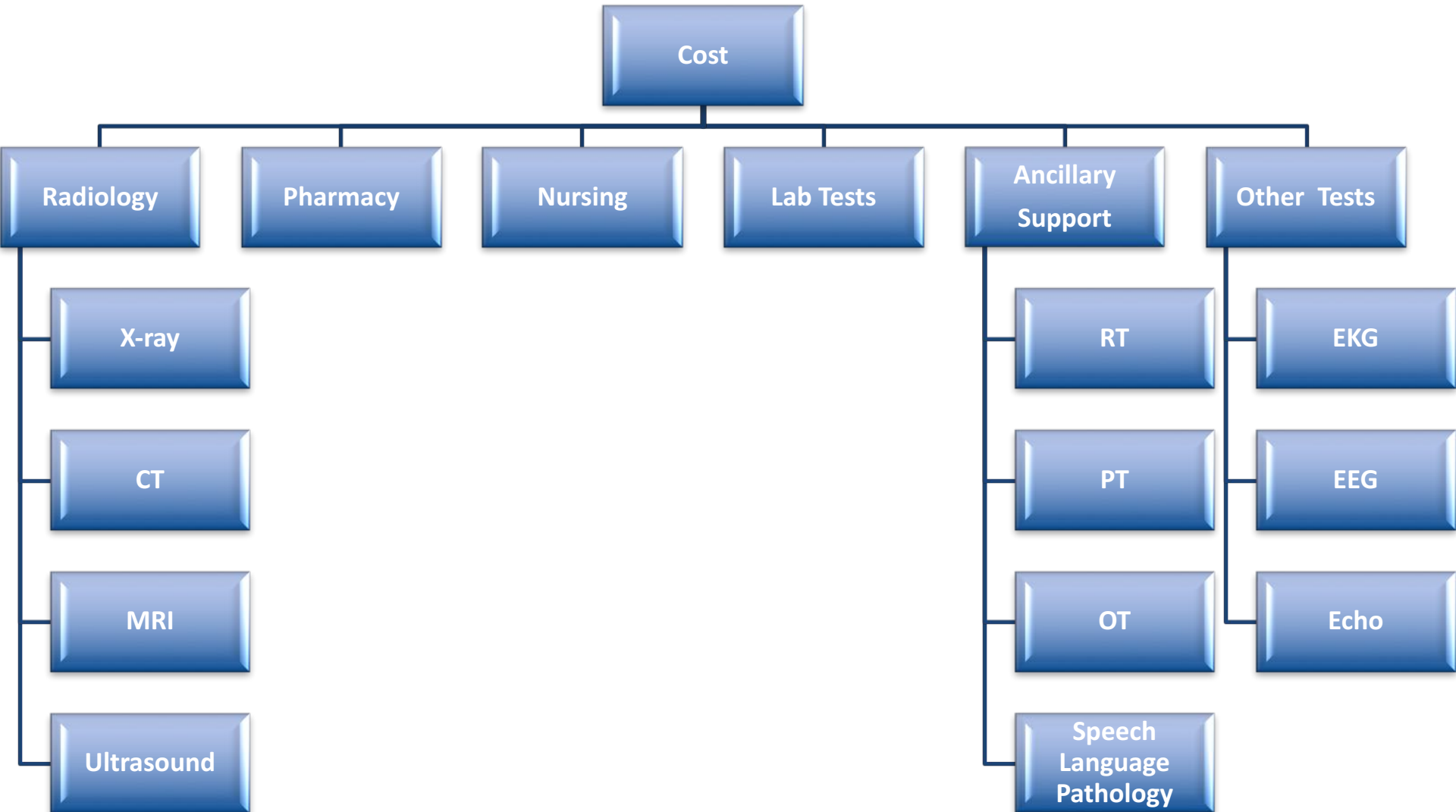


Median ICU LOS

	Pre EC3	Post EC3
ED to MICU	2.00	
ED to EC3 to MICU		3.00

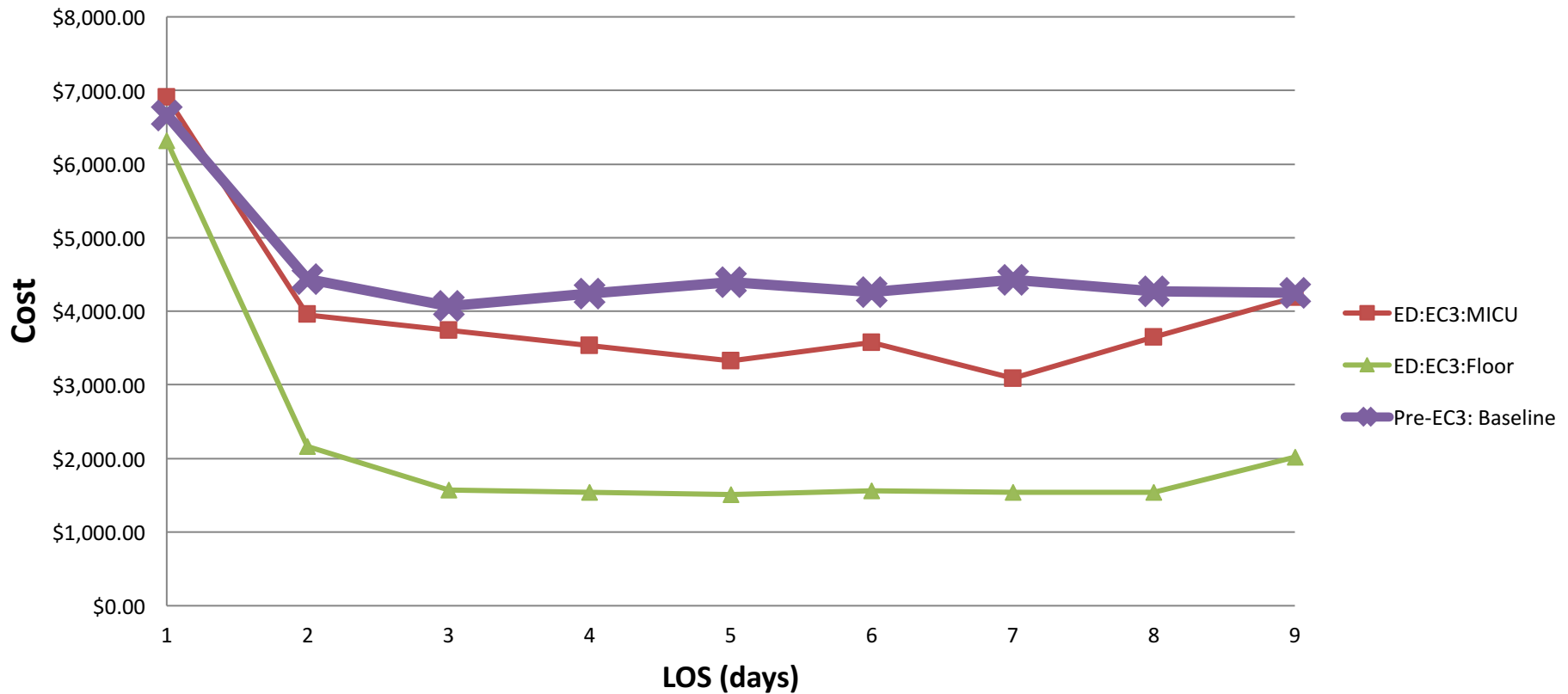


Cost Components



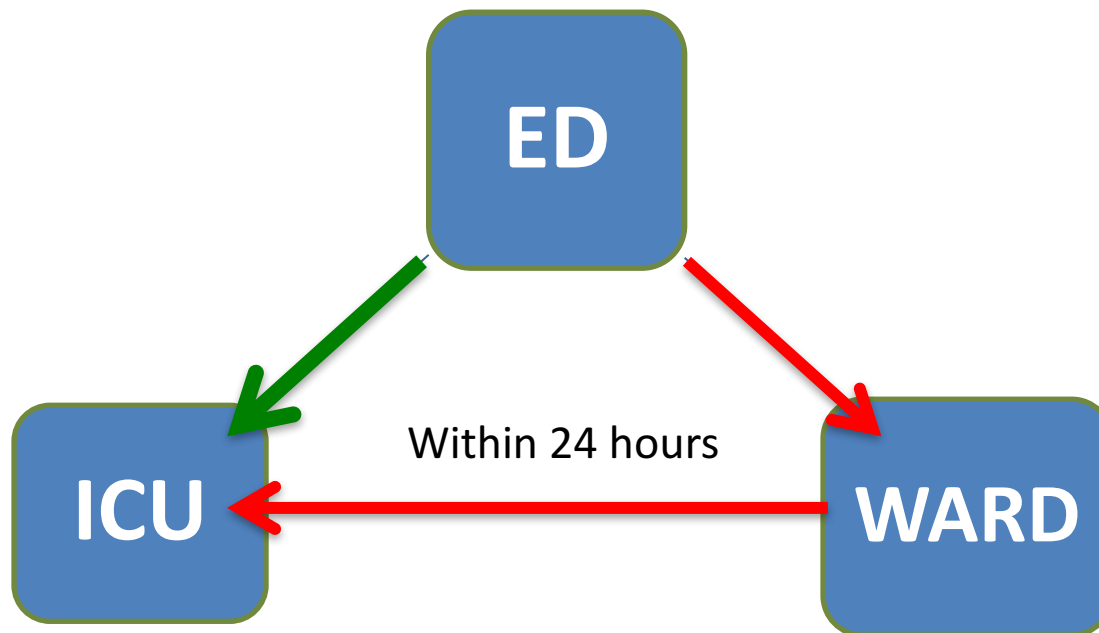
EC3 Cost Comparison

EC3 Cost Comparison



An Opportunity

WARD→ICU transfer is also associated with increased mortality



- 4x longer to get to ICU
- O.R. Death 3.07

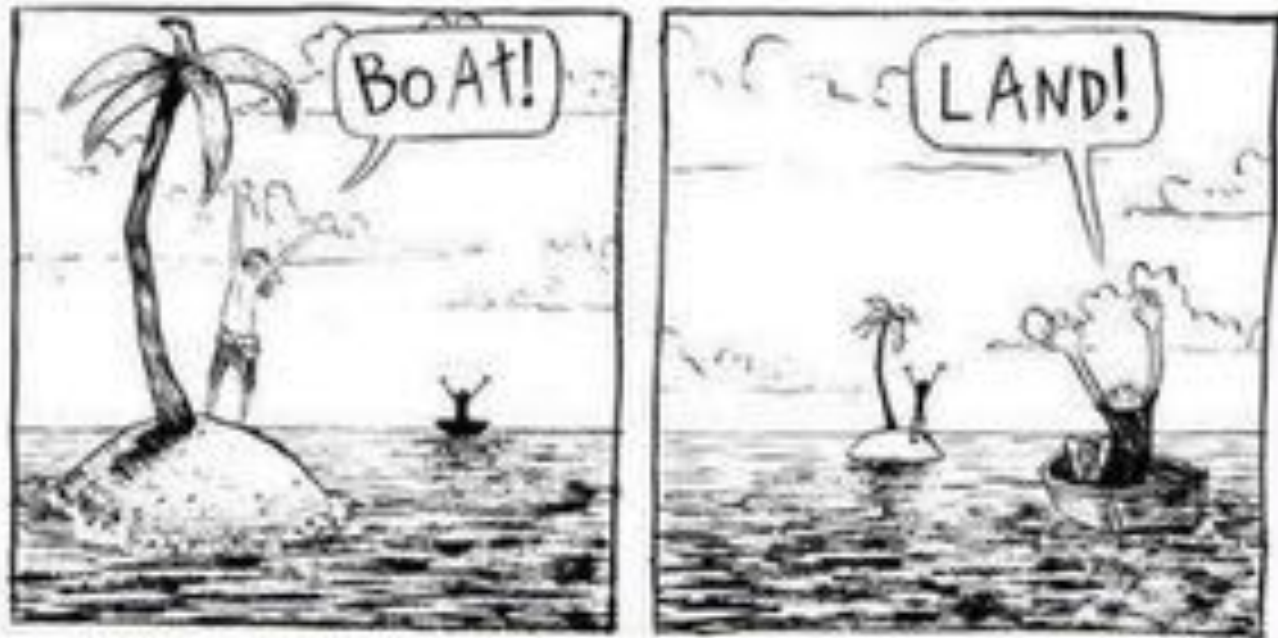
Incremental FTEs

- 7.5 Attending FTEs
- 7 PA FTEs
- 40 Nursing FTEs
- Dedicated RT

ED-ICU interface

- Transition zone between acute resuscitation and ongoing critical care delivery
- Needs-based treatment vs geography
 - Right Care Right Now
- Time sensitive, not time limited

Scope

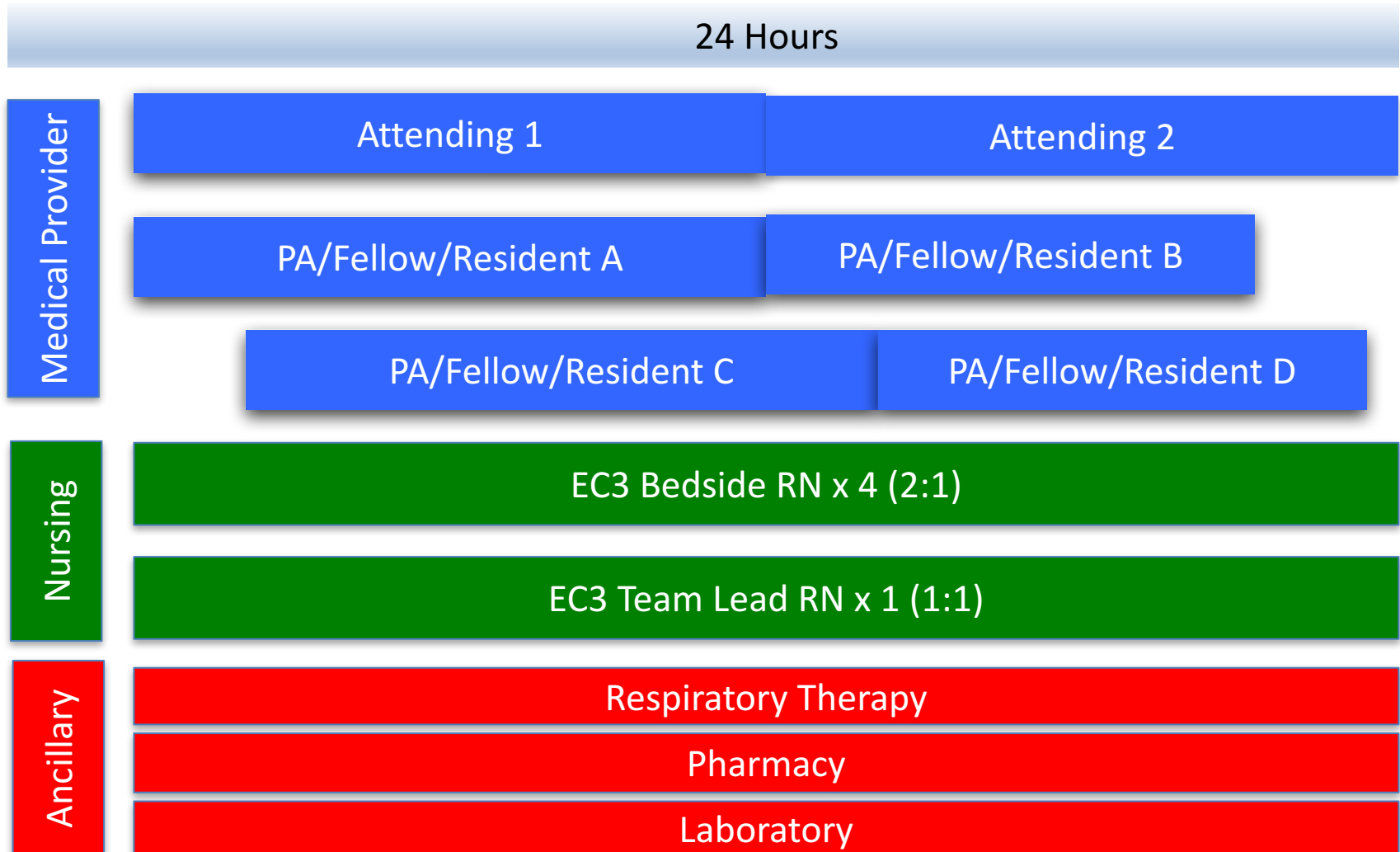


Perspective...

Roadmap

- Internal audit – Needs based assessment of current state
- Critical Care Assessment
 - Siloed
 - Specific space for specialized care
- Emergency Medicine Assessment
 - Emergency Critical Care emerging specialty (care/education/research)
 - Current staffing model
 - Current physical plant

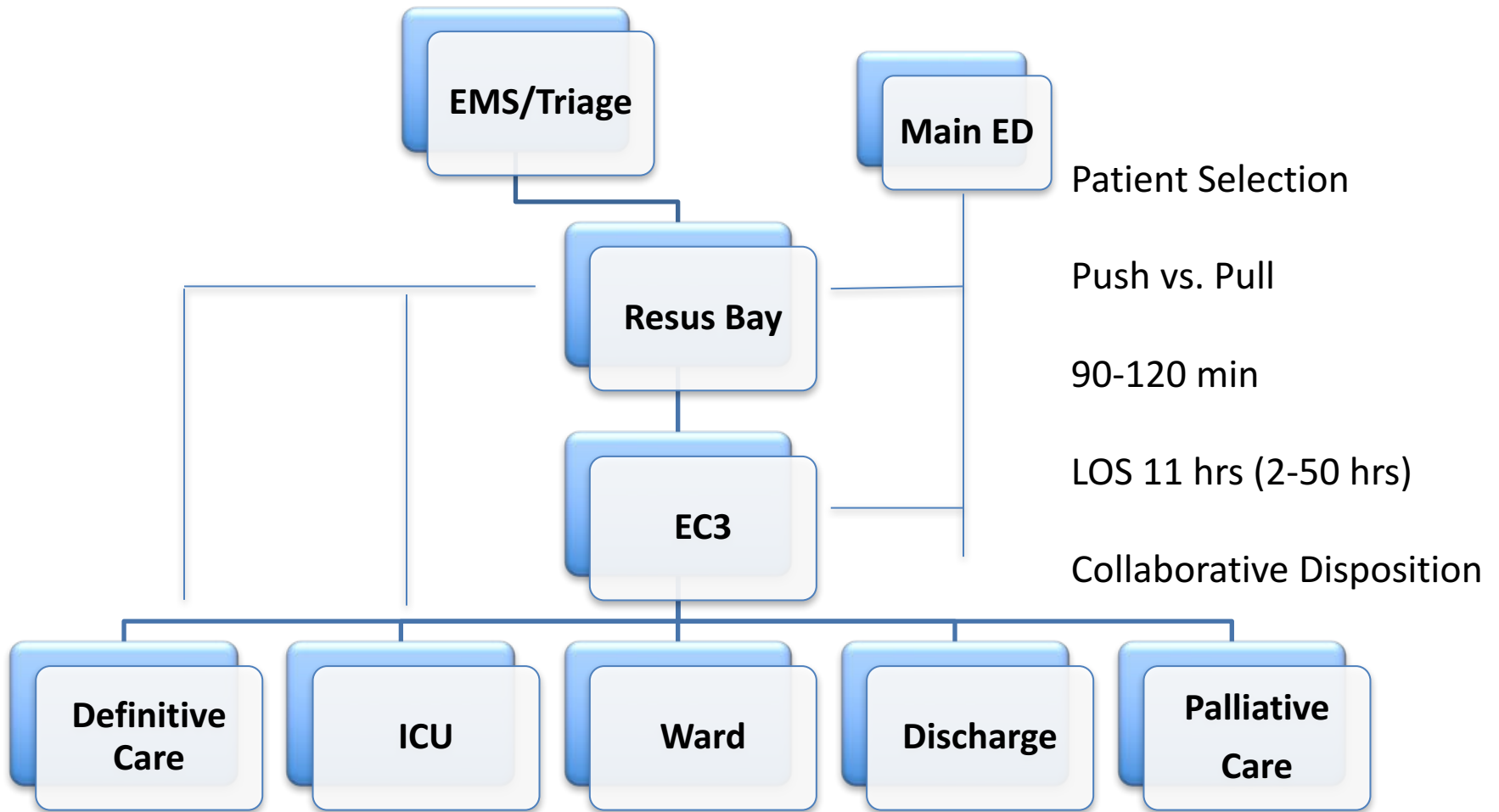
Staffing Model



Implementation Plan



EC3: Logistics and Patient Flow



Ribbon Cutting – Feb 2015



Eight Wastes of Healthcare

- Defects
- Overproduction
- Waiting
- Excess Processing
- Transporting
- Inventory
- Motion
- Not Using Talent

Grunden and Hagood. Lean-Led Hospital Design. CRC Press; 2012: 13-14

Cost Impact of LEAN

Invest in
Personnel/LEAN
Leadership



Higher
Up Front

Savings
Over
Time



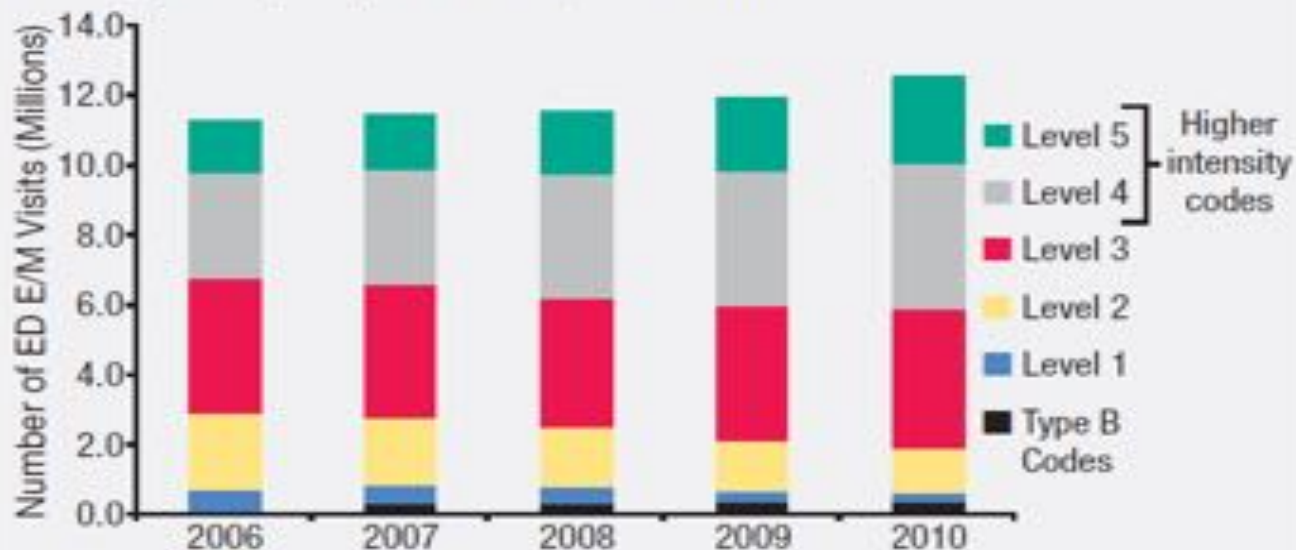
Process
Improvement
Reduces
Cost/Increases
Value Over
Time

Returns

Intensity of ED Services Increasing

Medicare FFS beneficiaries are receiving a greater volume and intensity of ED services.

Chart 1: Number of Medicare FFS ED Visits by Evaluation and Management (E/M) Visit Code, 2006-2010



Source: The Moran Company, *Trends in the Provision of Emergency Department Evaluation and Management Services*, January 2013.

Collaborative Model

- CC advisory group formed in 2012 –
 - Medical directors and unit representatives from all inpatient adult ICUs
- Agreed upon basic treatment protocol/strategy for most common admissions
 - Sepsis
 - Cardiac arrest
 - Respiratory Failure
 - GI Bleed
 - Anticoagulation reversal
 - SAH

Outline

- Introduction to Michigan Medicine
- Define LEAN
- LEAN Tools
- Pressures Affecting Emergency Care
- Demonstrative Case Presentation
- Summary/Wrap-Up

People

- Engage all workers
 - Frontline, Middle Management, Admin Leadership
 - All Job Families Affecting Patient Experience
- Empowers
- Fosters Teamwork Across Job Families
- Frequently Uncover Larger Systems Issues
- Leaders' primary job is to grow more leaders

Emergency Care System Stressors

Quality

- Value not Volume
- Hospital Acquired Infections
- Medical Errors

Flow

- Increasing Volumes
- Sicker Patients
- Lack of PCP Access

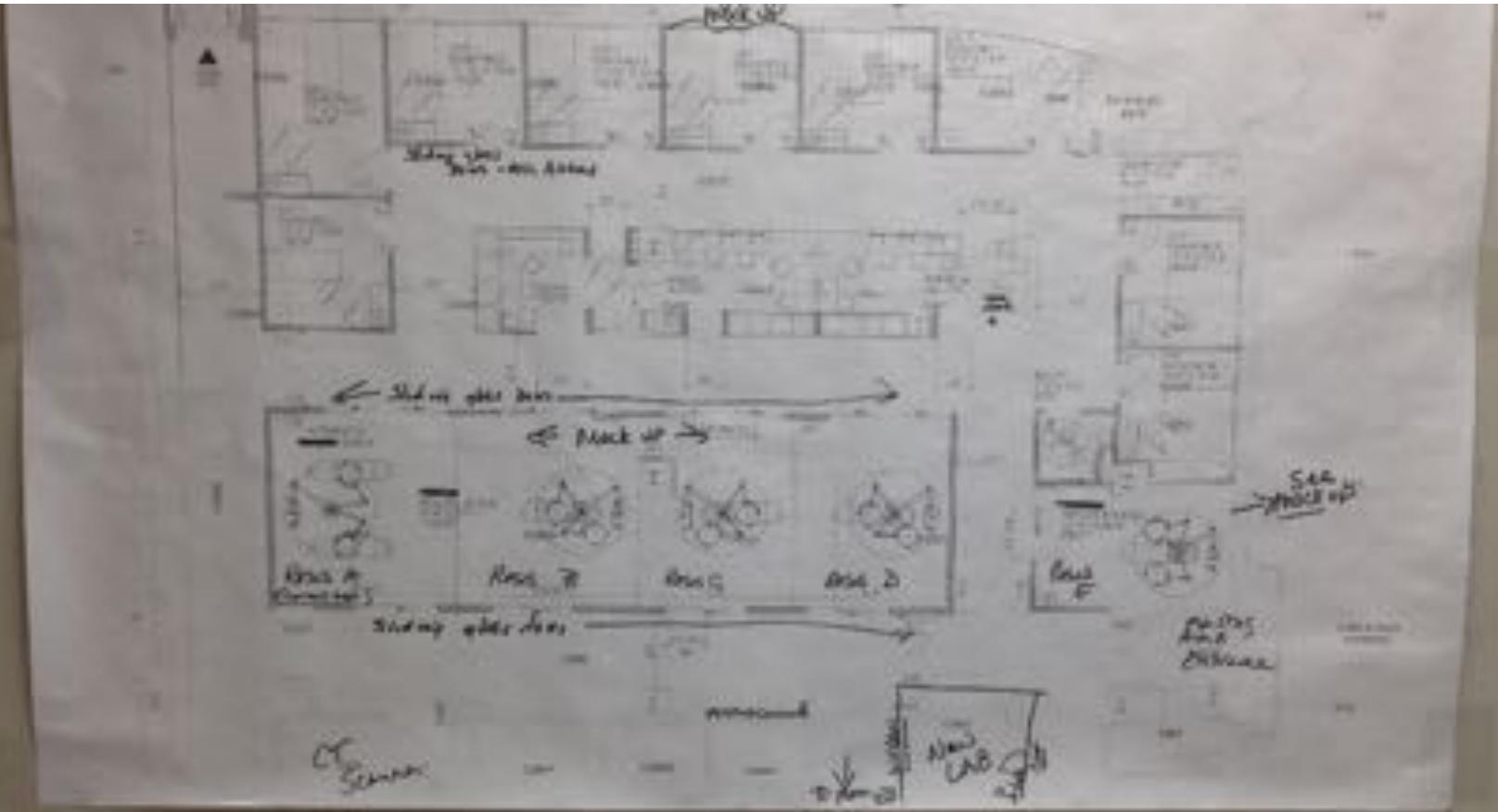
Financial

- Rising Costs
- Decreasing Reimbursement
- Capitated Payments
- Accountable Care
- Repurposing Existing Space

Physical Space Insufficient to Meet Current & Forecasted Demand



Full Scale Mock-up



Please write your suggestions on
Sheet in each room or email

Multidisciplinary Teams



Health System Strategic Plan

- Execution of the UMHS Strategic Plan to **double adult high complexity market share** (from 6%- to 12%) will amplify the demand for emergency critical care in our system
- **The emergency care system, in it's current structure, is *not prepared to respond to these challenges.***



Roadtrips

 **Herman Miller**

 **SKYTRON**[®]

SPECTRUM HEALTH



ThedaCare[™]

stryker[®]

Hill-Rom[®]

STORZ
KARL STORZ — ENDOSKOPE







Rarely used but critical procedural items

Centralized, commonly used items

Michigan Medicine - Facts & Figures

Patient Care Activity FY 2016

Patient Clinic Visits	2,320,254
Observation Cases	17,827
Hospital Discharges	48,793
Surgical Cases	54,342
Survival Flight Missions	1,227
Emergency Dept. Visits	104,219



Golden Tickets



Lessons Learned



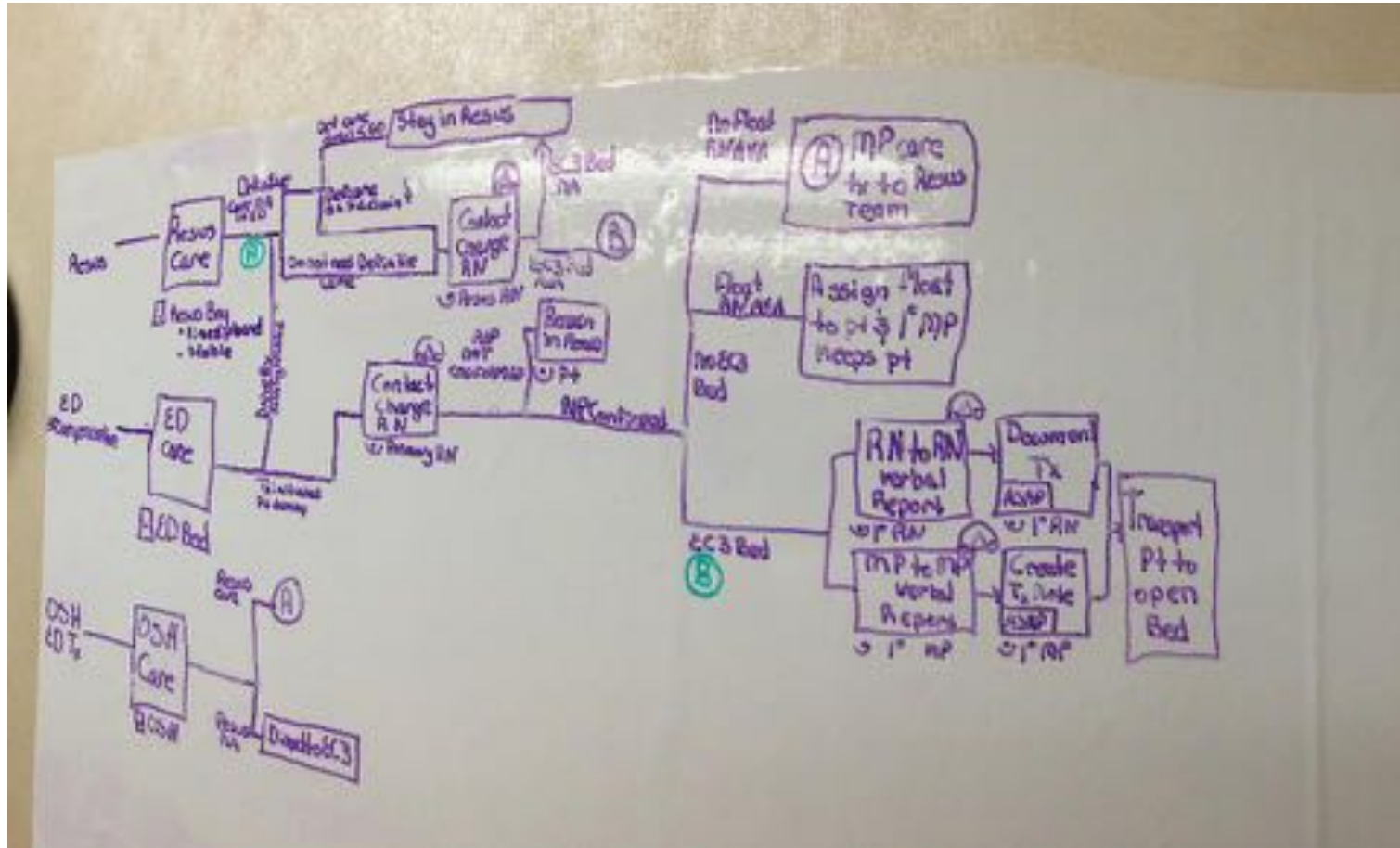
Storage Space/Technology



Full Scale Mock-up



Value Stream Mapping

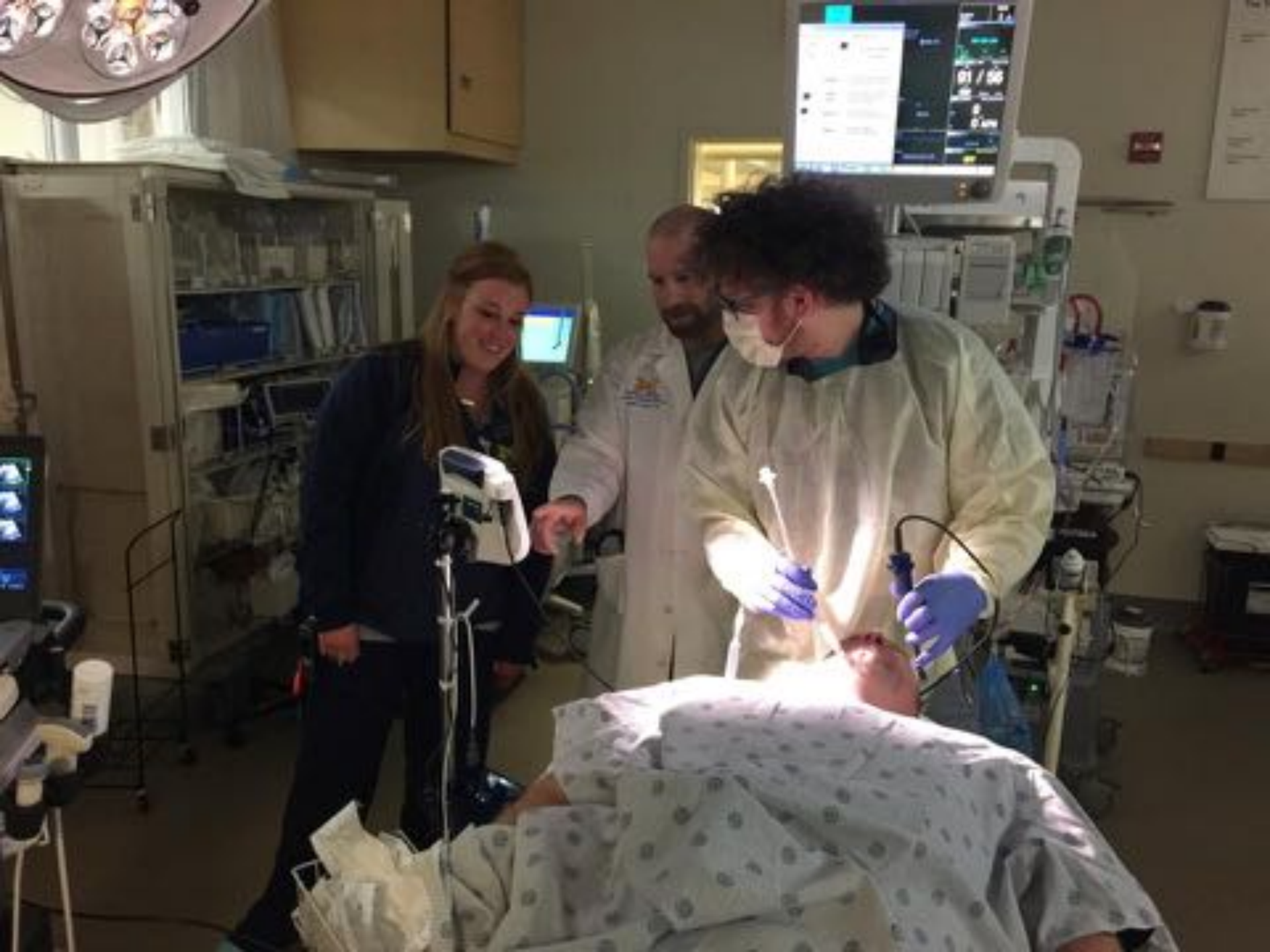


Page to Board (1/11, 1/11)

Page to Board (1/11, 1/11, 1/11)

ECG







Fiberoptic video image can be displayed on multiple HD screens around RESUS bay



