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)

A3

BACKGROUND/PROBLEM

Defining the problem is CRITICAL

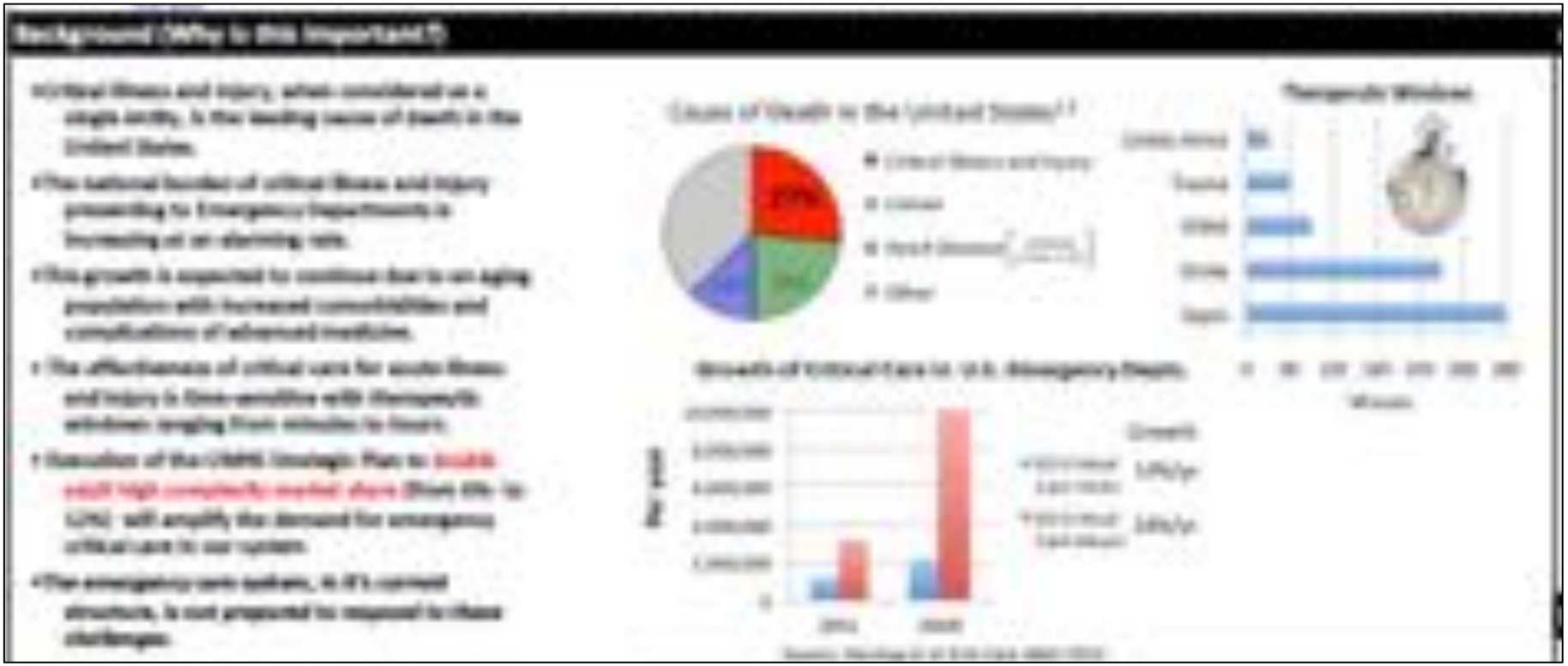
- Why is this important?
- Why now?

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

Background



Michigan Medicine

UMHS Admission Streams: ED = Front Door

54%

16%

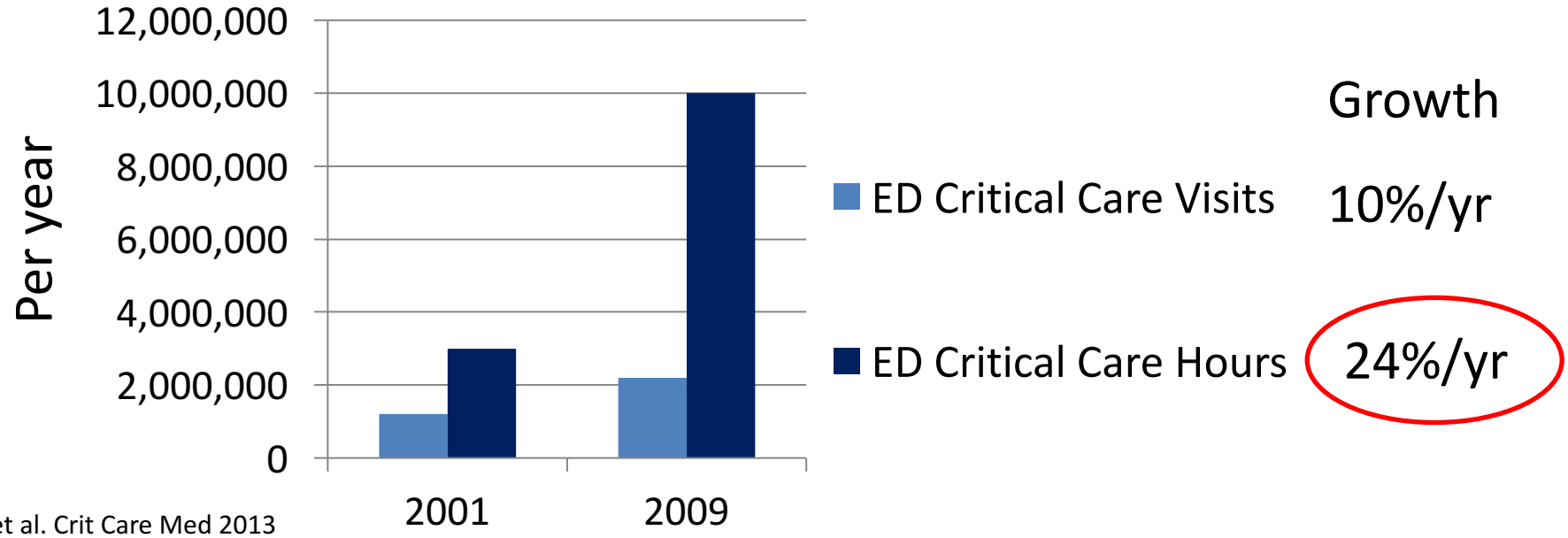
30%

FY16 UMHS inpt/obs admissions = 66,620

An Alarming National Trend

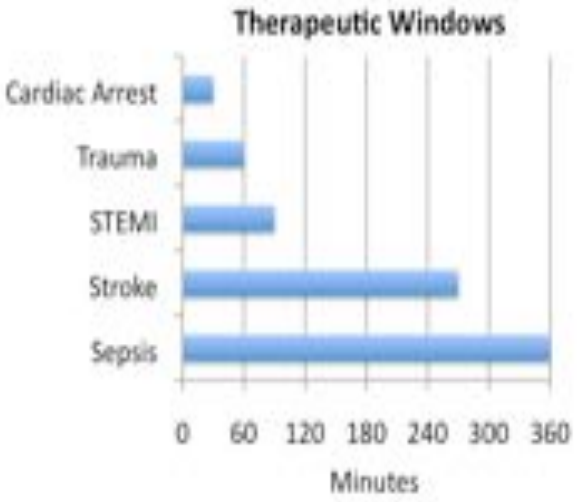
ICU admissions from the ED have DOUBLED over the last decade

- 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**

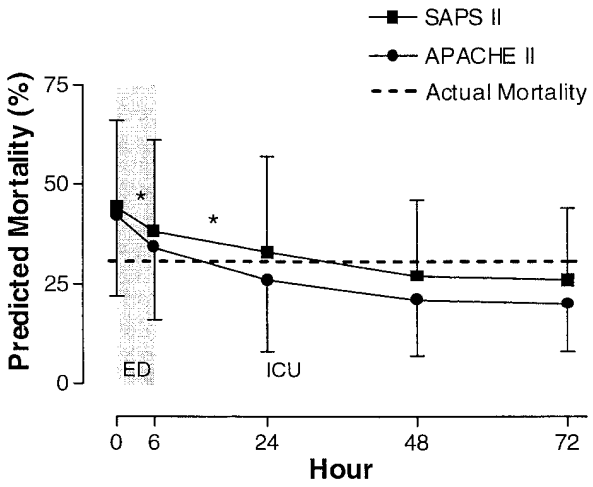


Herring et al. Crit Care Med 2013

Acute Critical Care is time-sensitive



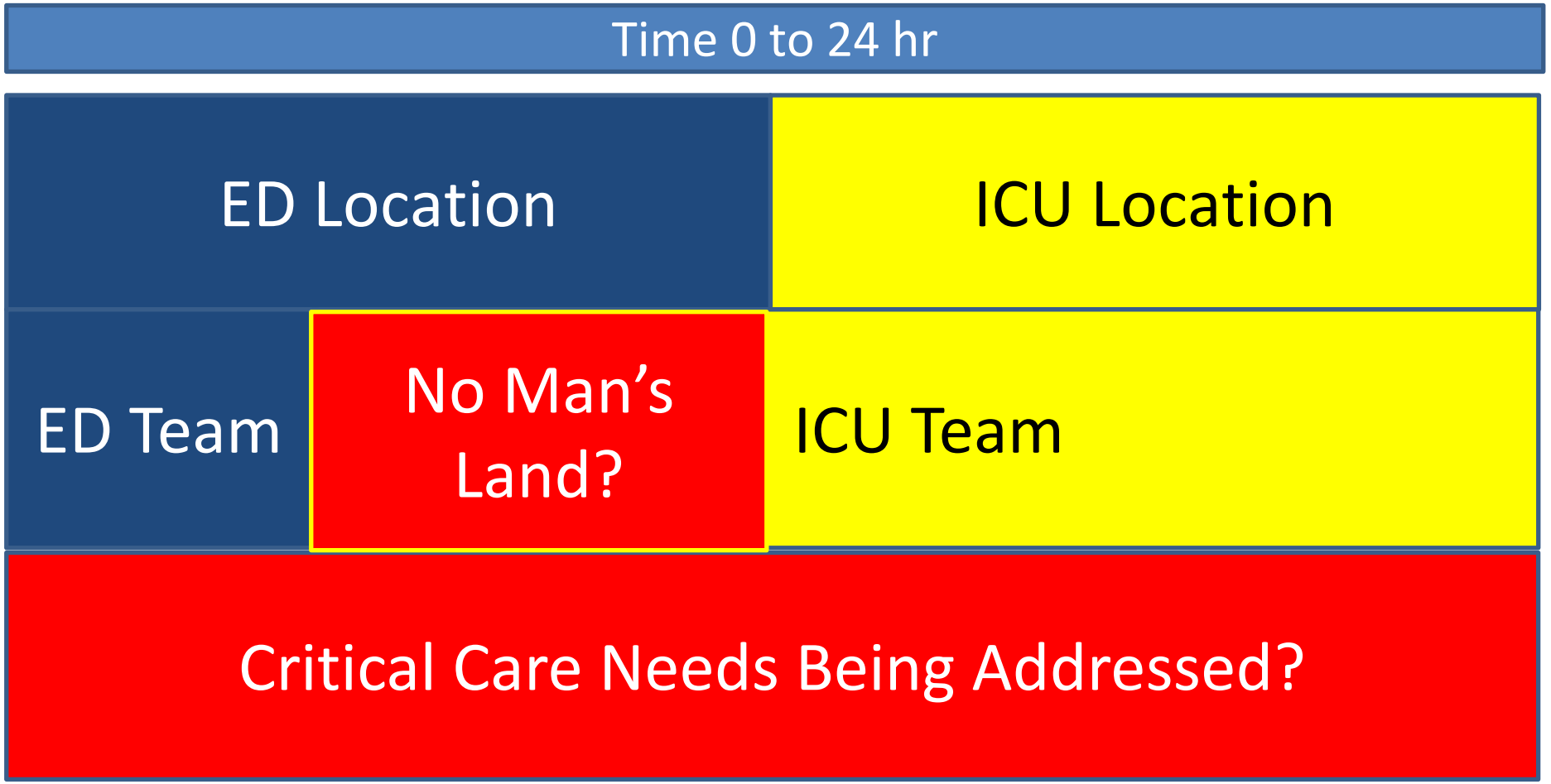
The effectiveness of critical care for acute illness and injury is time-sensitive with therapeutic windows ranging from minutes to hours.



Nguyen 2000

The FIRST 6 HOURS
Most rapid change in physiology

ED-ICU Interface

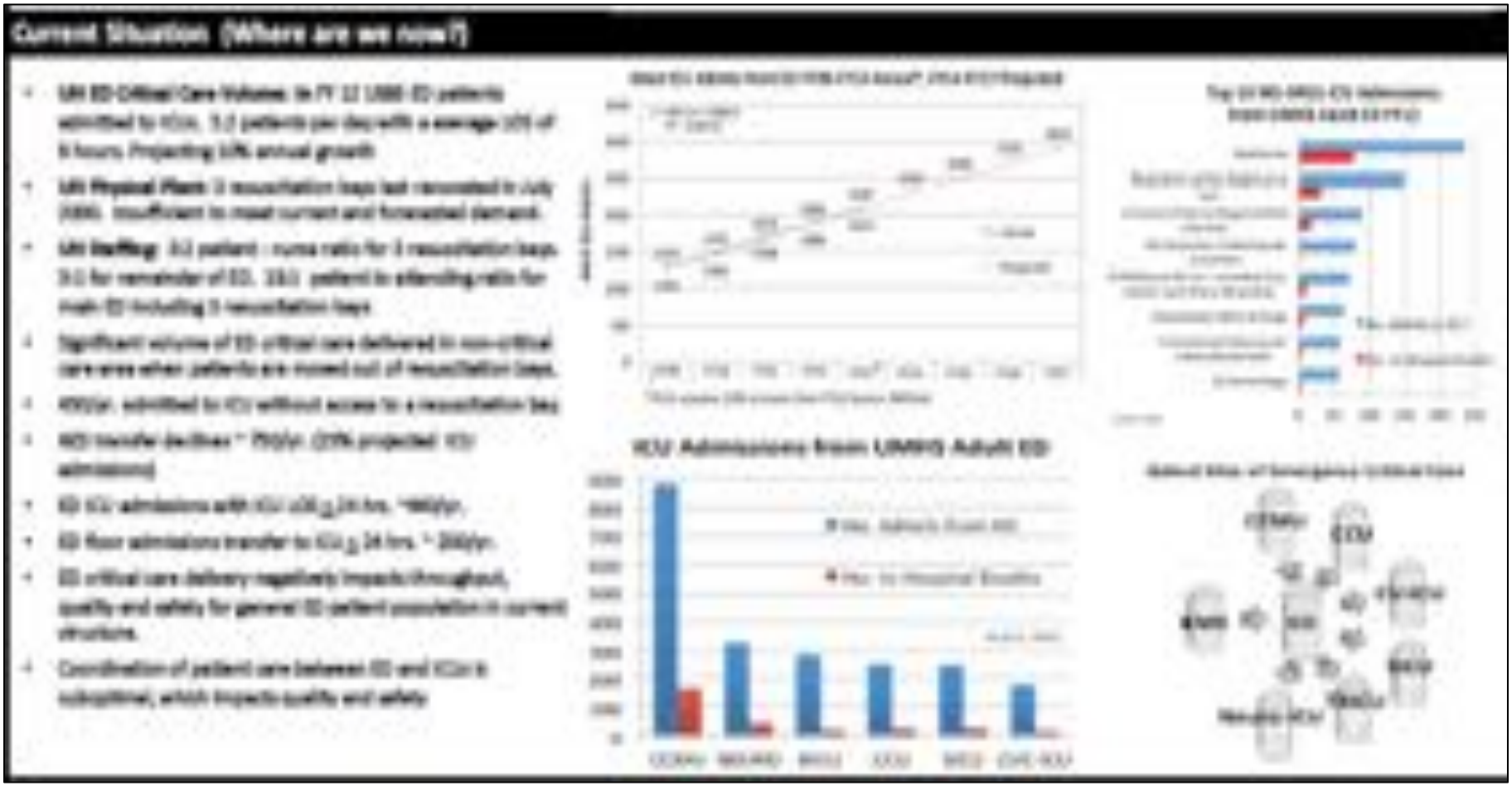


Current State/Analysis

Department of Emergency Medicine

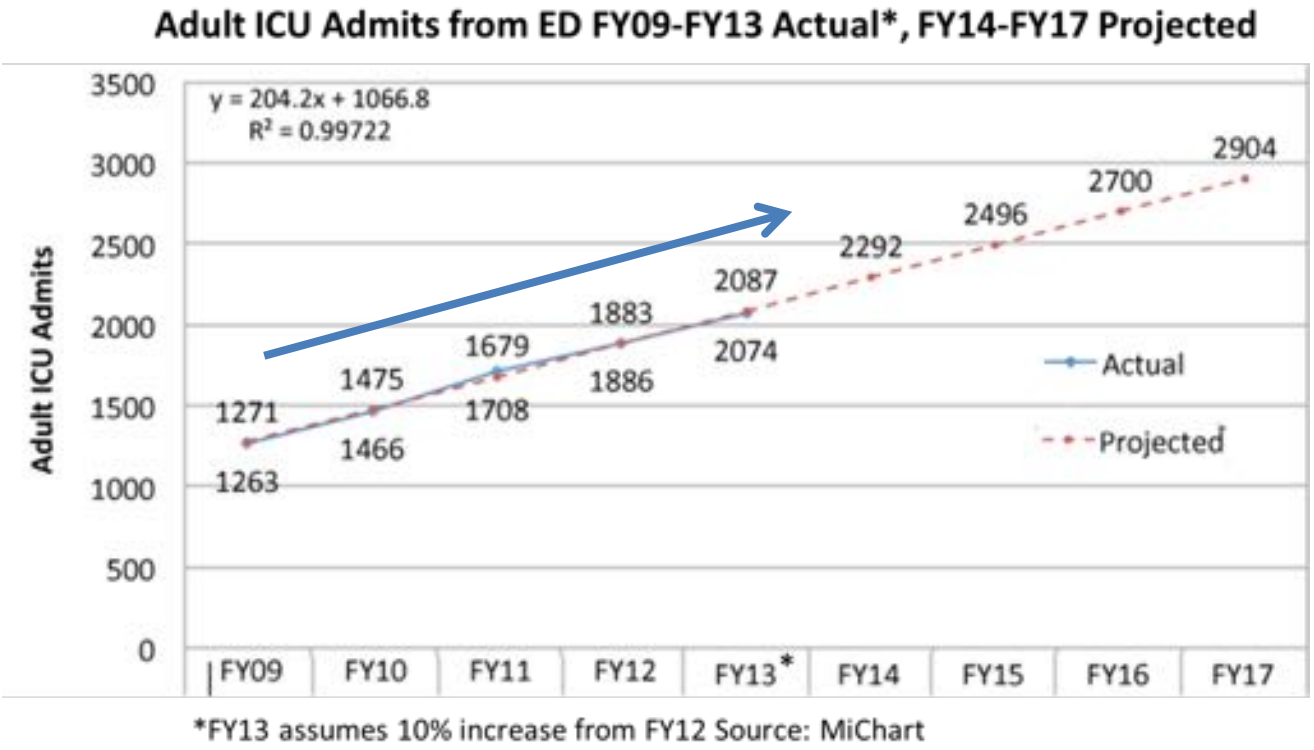
MICHIGAN MEDICINE
UNIVERSITY OF MICHIGAN

Current Situation – Where are we now?

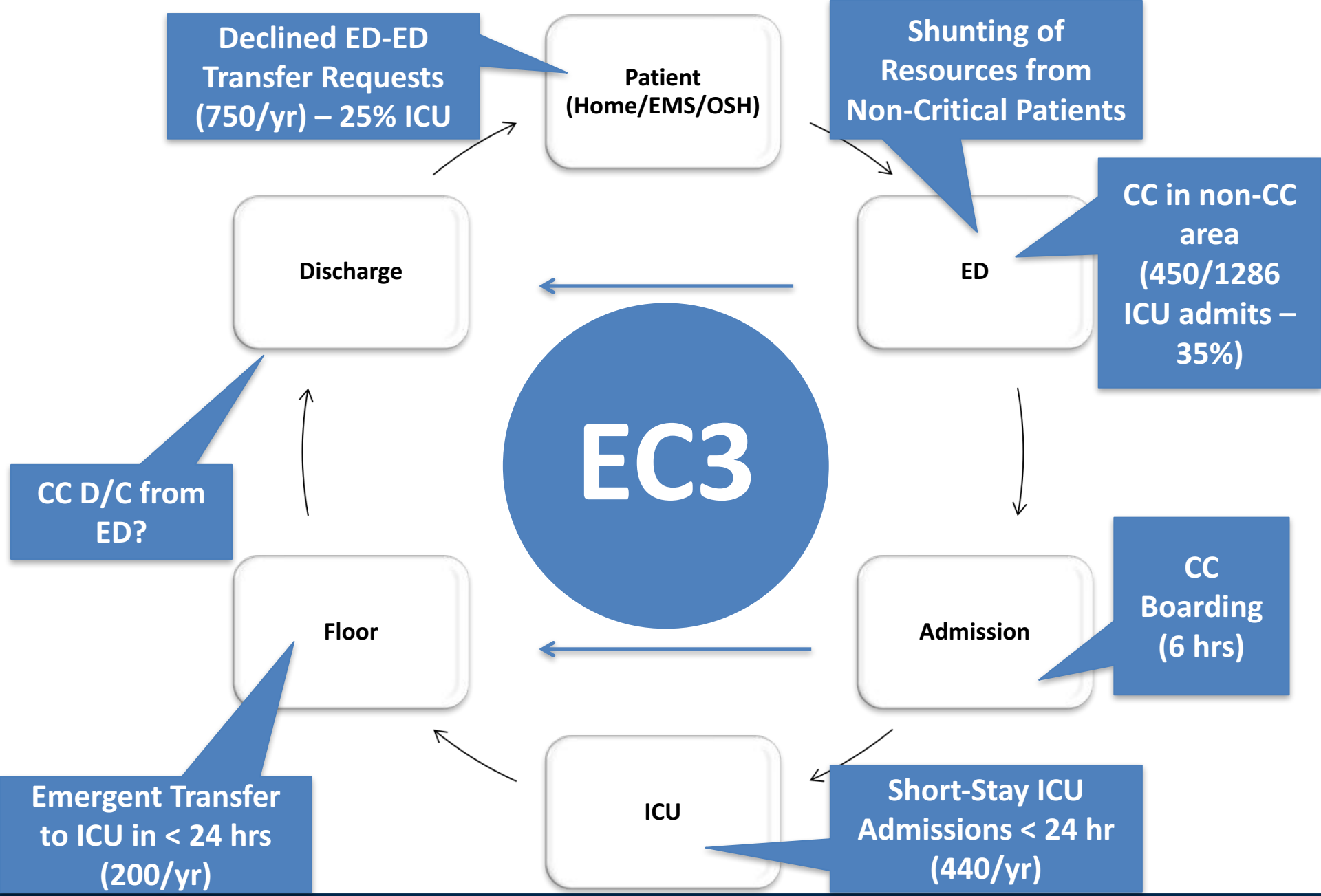


Current state 2012 – ICU Admissions

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



*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
Discharge
ED
CC in non-CC area (450/1286 ICU admits – 35%)
EC3
CC D/C from ED?
Floor
Admission
CC Boarding (6 hrs)
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 UM Adult ED.

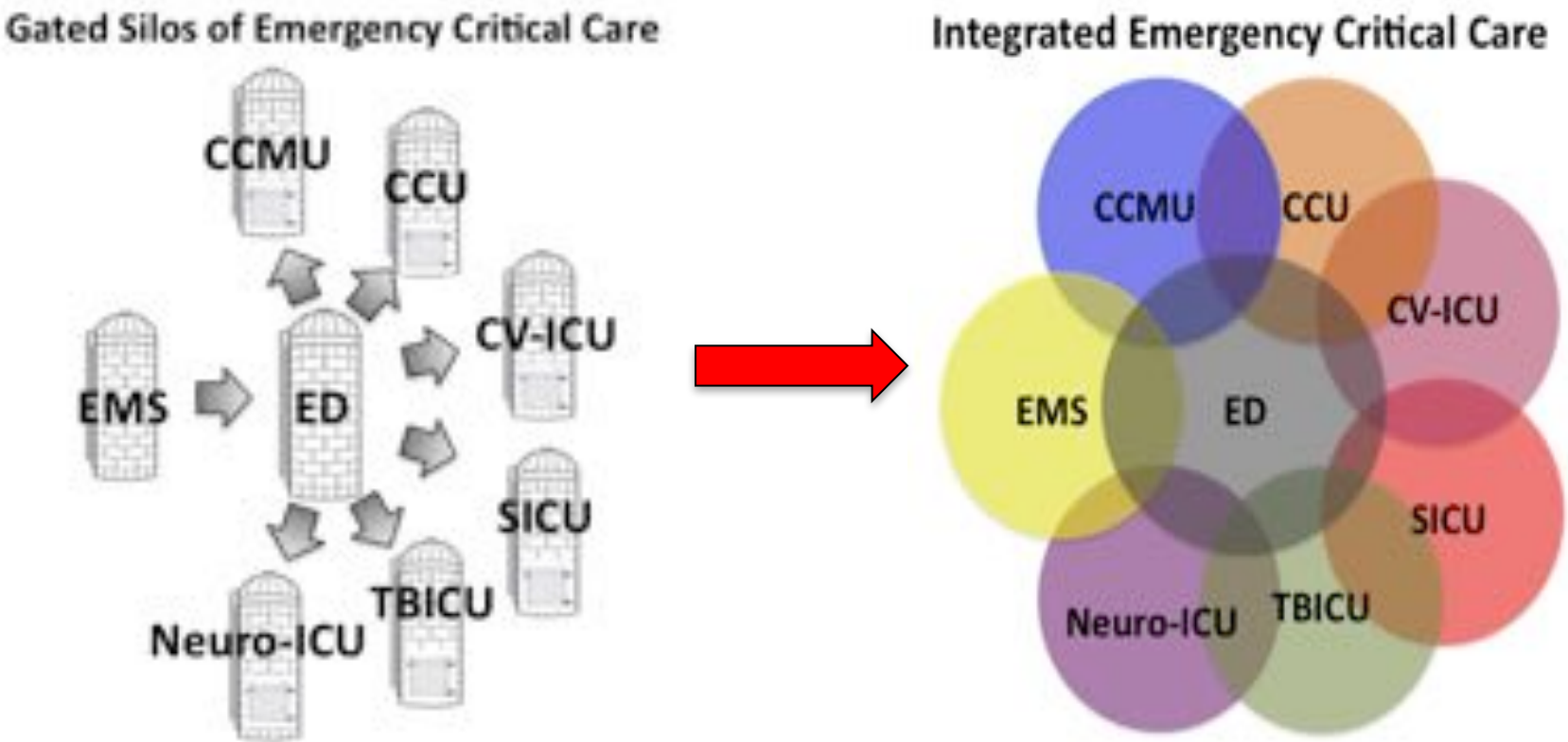
- EM Division of Critical Care, Division Chief, and EC3 Medical Director
- Establish an ED Critical Care Center by renovation of 6000 sq. ft. currently occupied by ED Resuscitation, ED North (old CES)
- 24/7 EC3 attending staffing: EM Faculty with EM/CC board certification or additional training/credentialing. 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:

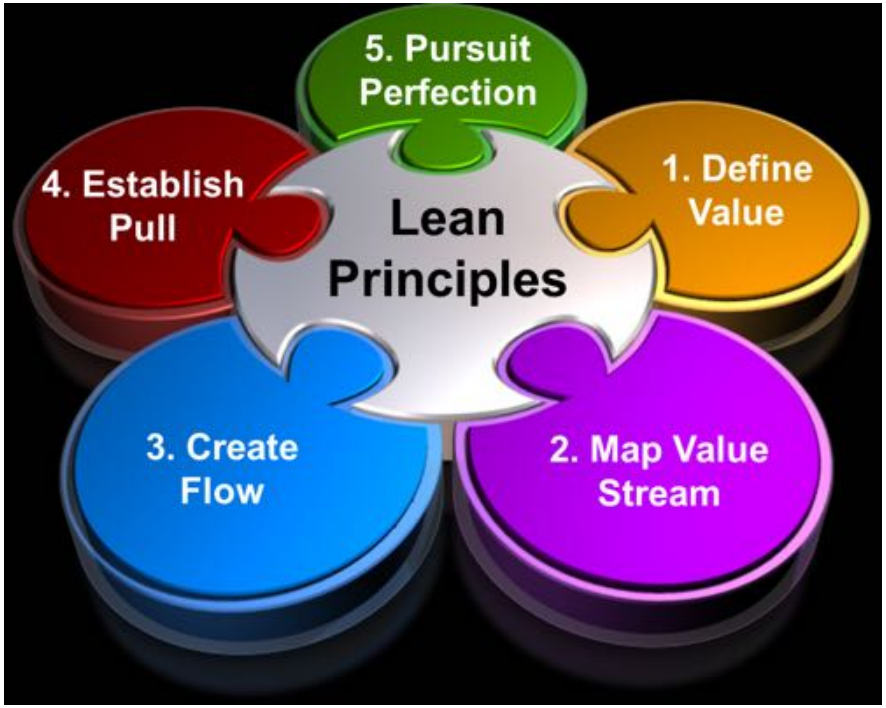
- Max patients per day =15. 15x 365 = 5475 pt/yr. LOS ~12 hours. Beds=9
- Forecast EC3 patients: Current activity = 1696 pt/yr. (31% occ) 5 yr goal = 5110 (93% occ).
- Impact on inpatient capacity mitigated by initiatives to develop alternatives to admission for general ED patients

Project Cost : $7 mil ($3.5 construction, $3.5 capital equipment)
NPV range: ($0) to $3 mil (calculated on incremental activity only)

Paradigm Shift



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

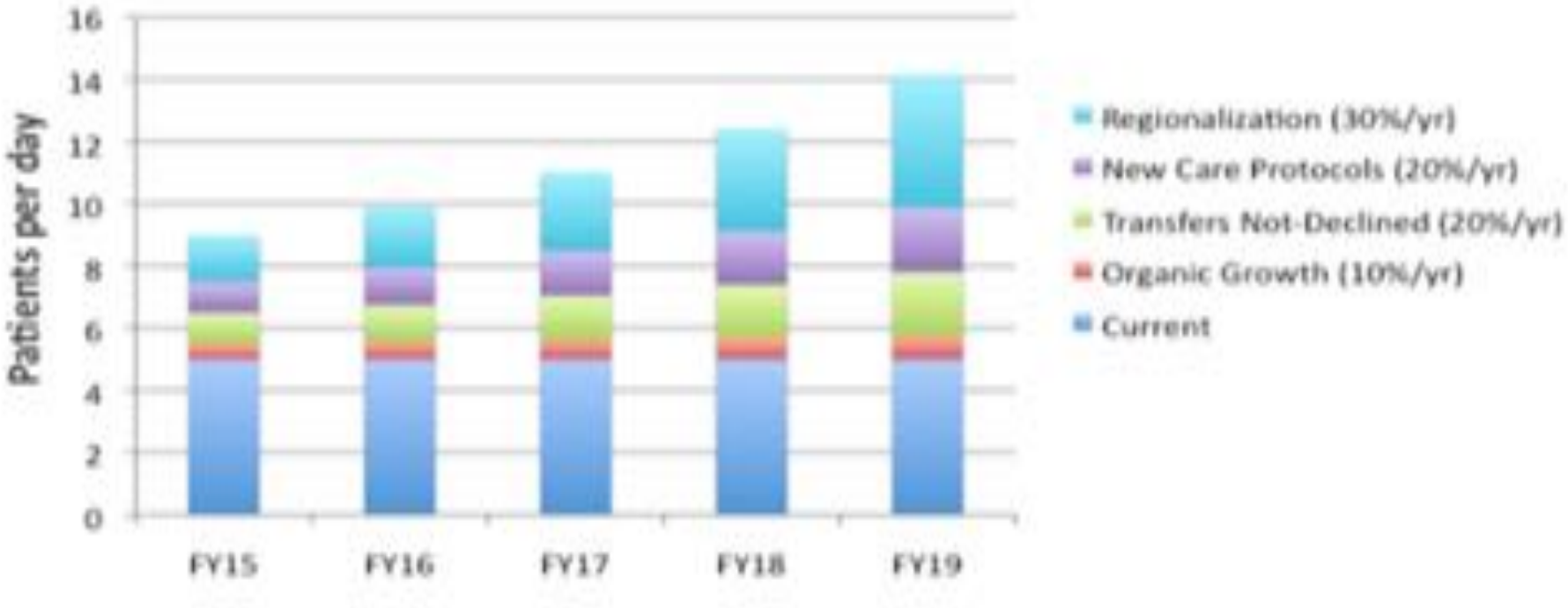
- Purpose – fix patients' problems definitively
- Process – fundamentally redesign the processes (not just tightening up the old way)
- People – a true multidisciplinary team

Queueing Model

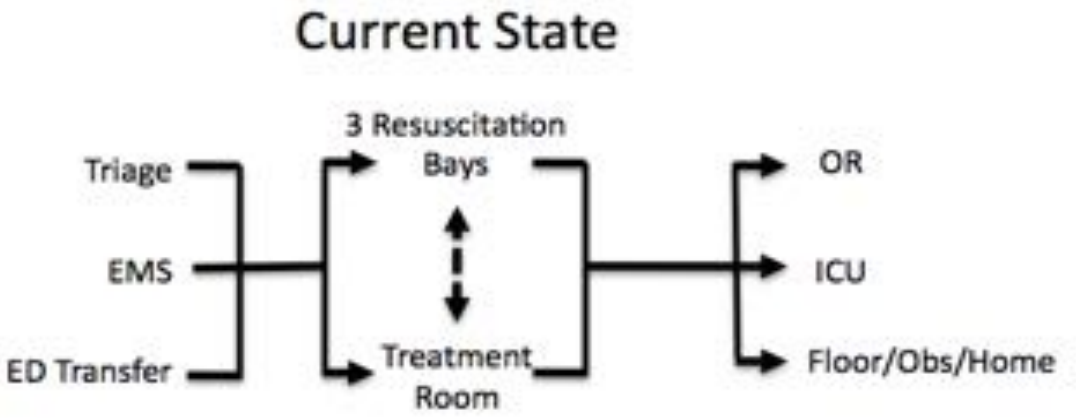
- Assumptions:
  - Current volume
  - EC3 LOS – 12 hrs
  - 50% of patients treated in resuscitation bays would pass through EC3
  - 10-20% of patients would no longer need ICU

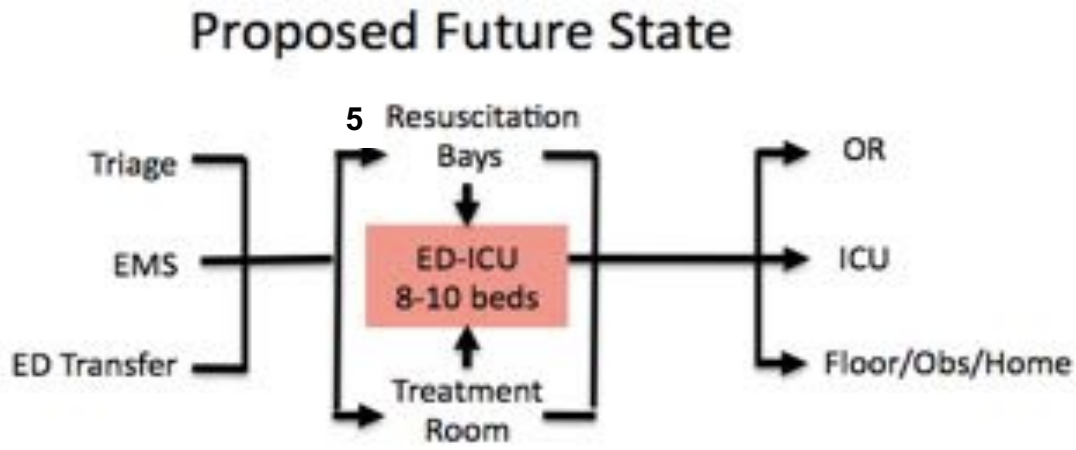
- **Model Output:**
  - **Require 5 resuscitation bays and 7 EC3 rooms**

Growth Projection



Proposed Future State





Creating a Multidisciplinary Team

Many team meetings 2 years prior

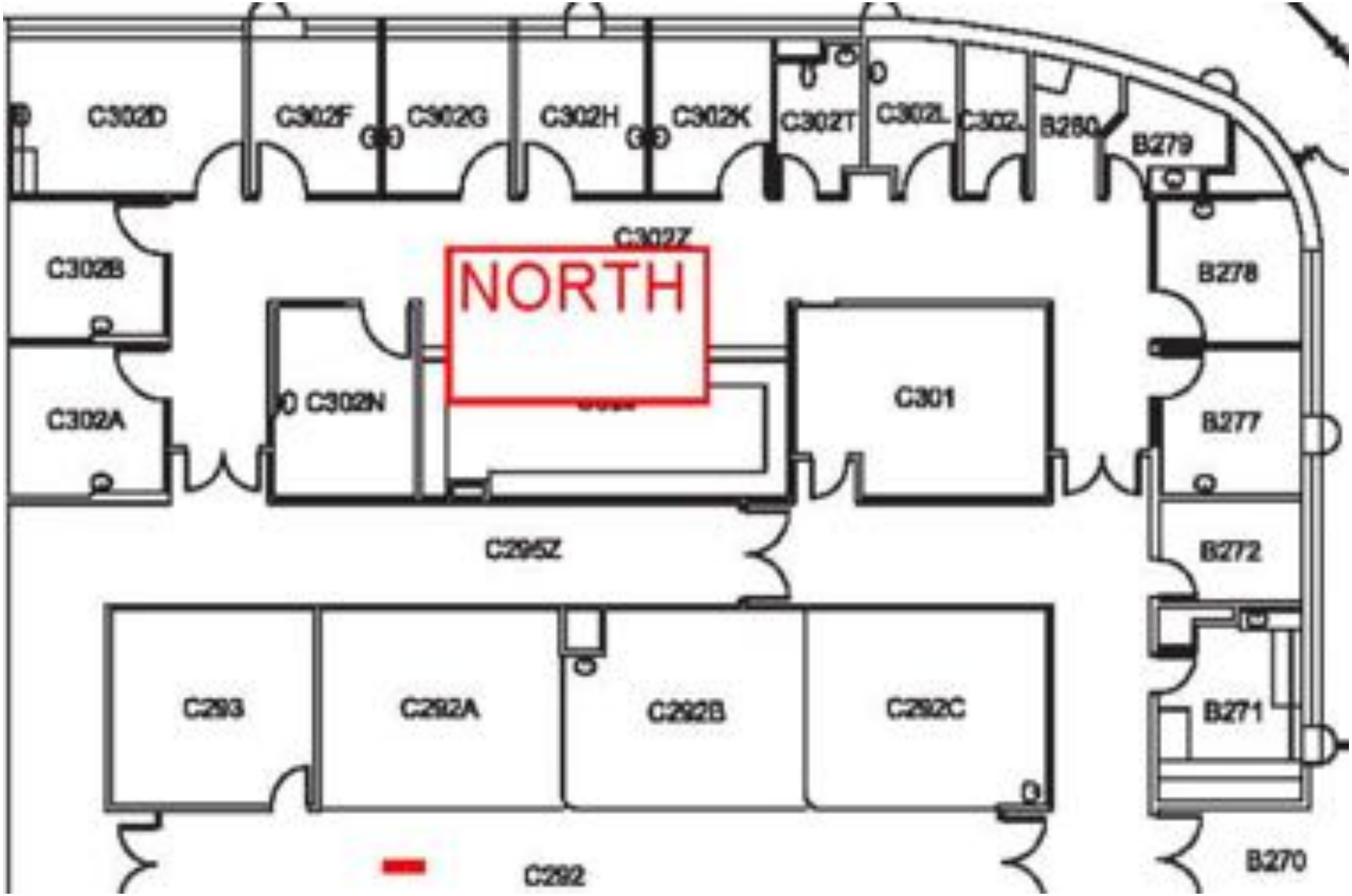
Key LEAN Tools

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

Roadtrips

SCHEMATIC DESIGN


NORTH
MAIN
TRIAGE
PES
SOUTH
EAST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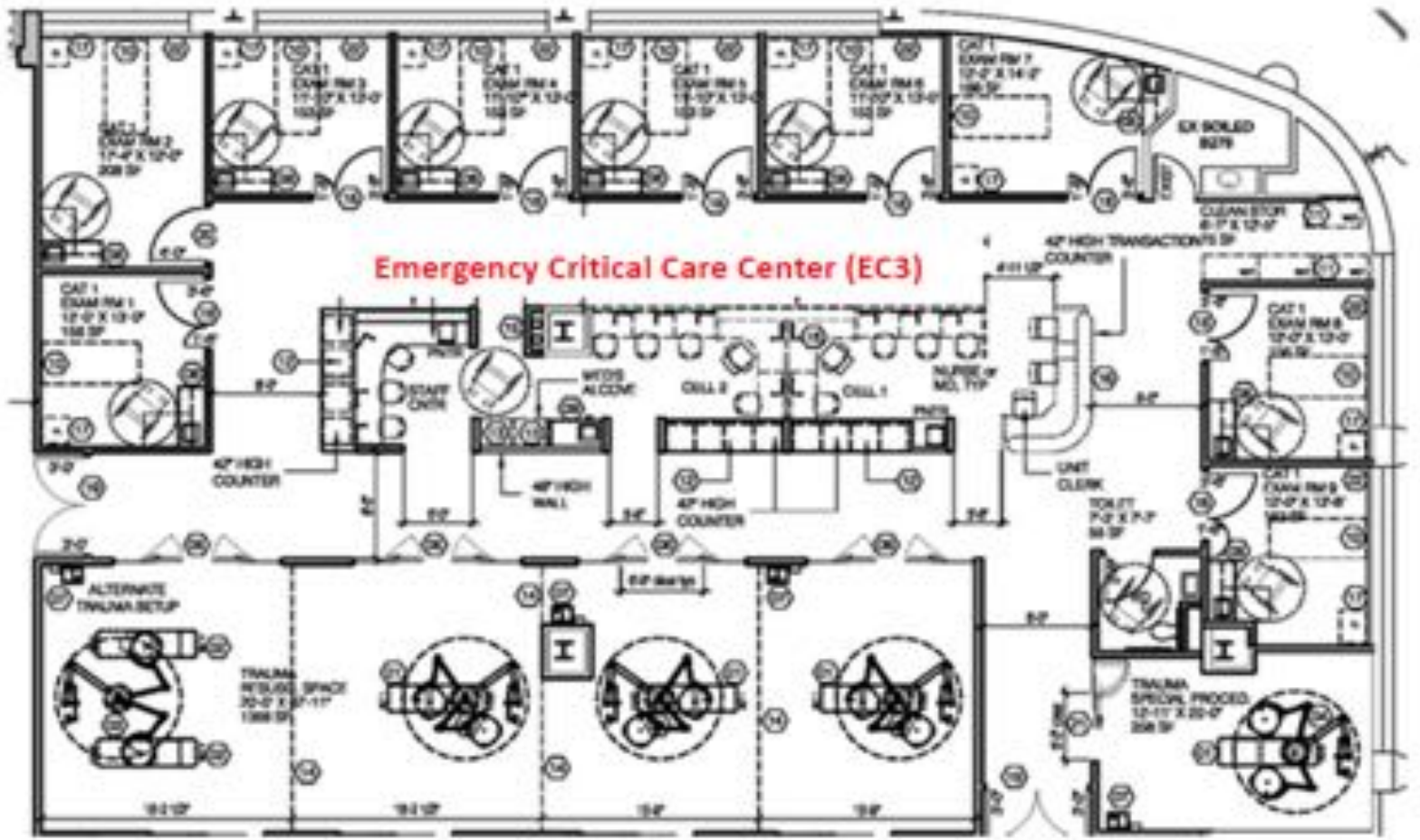
EC3 v1.0



Full Scale Mock-up

Utilize Actual Equipment

Multidisciplinary Teams

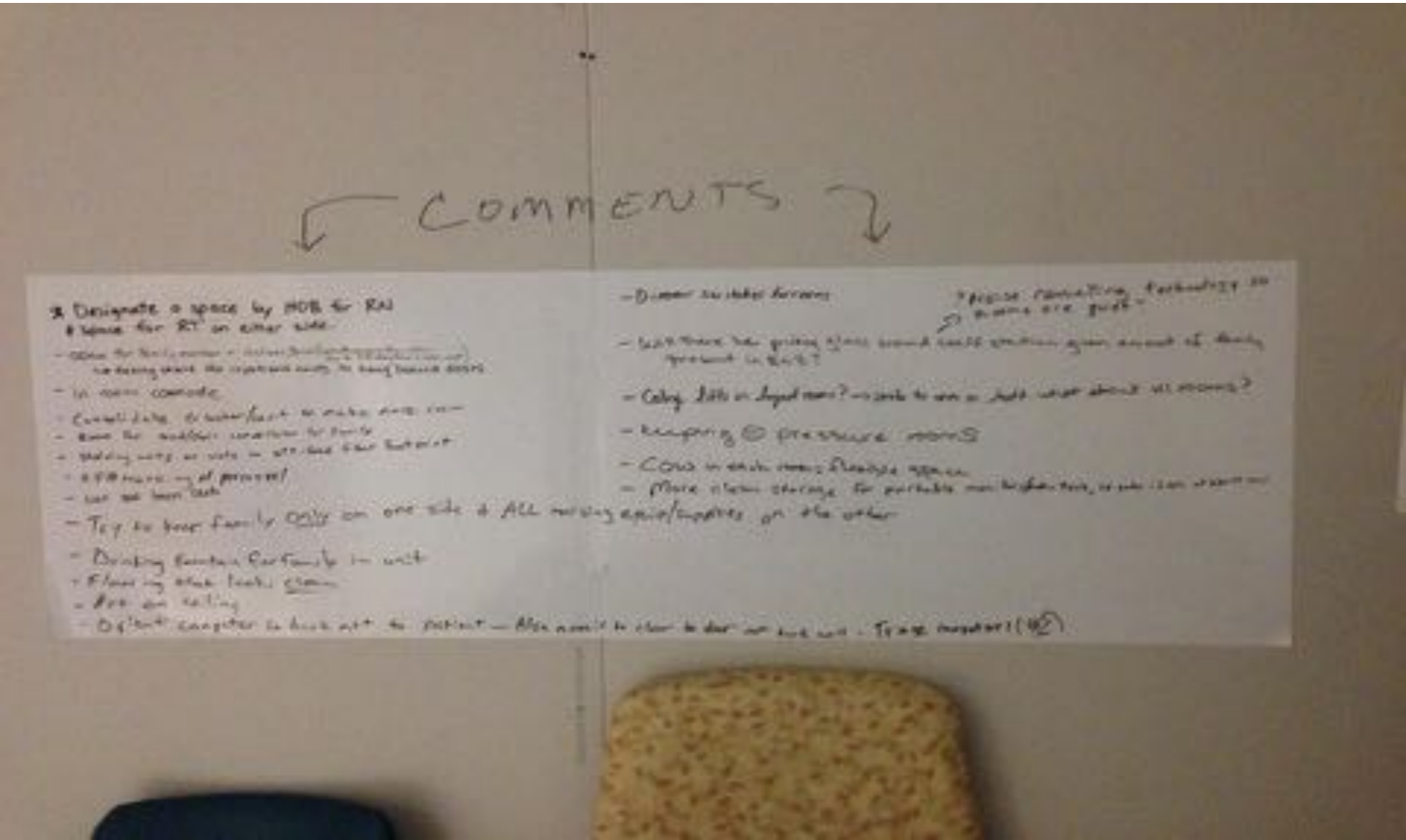
Multidisciplinary Teams

Egress

Immovable Barriers

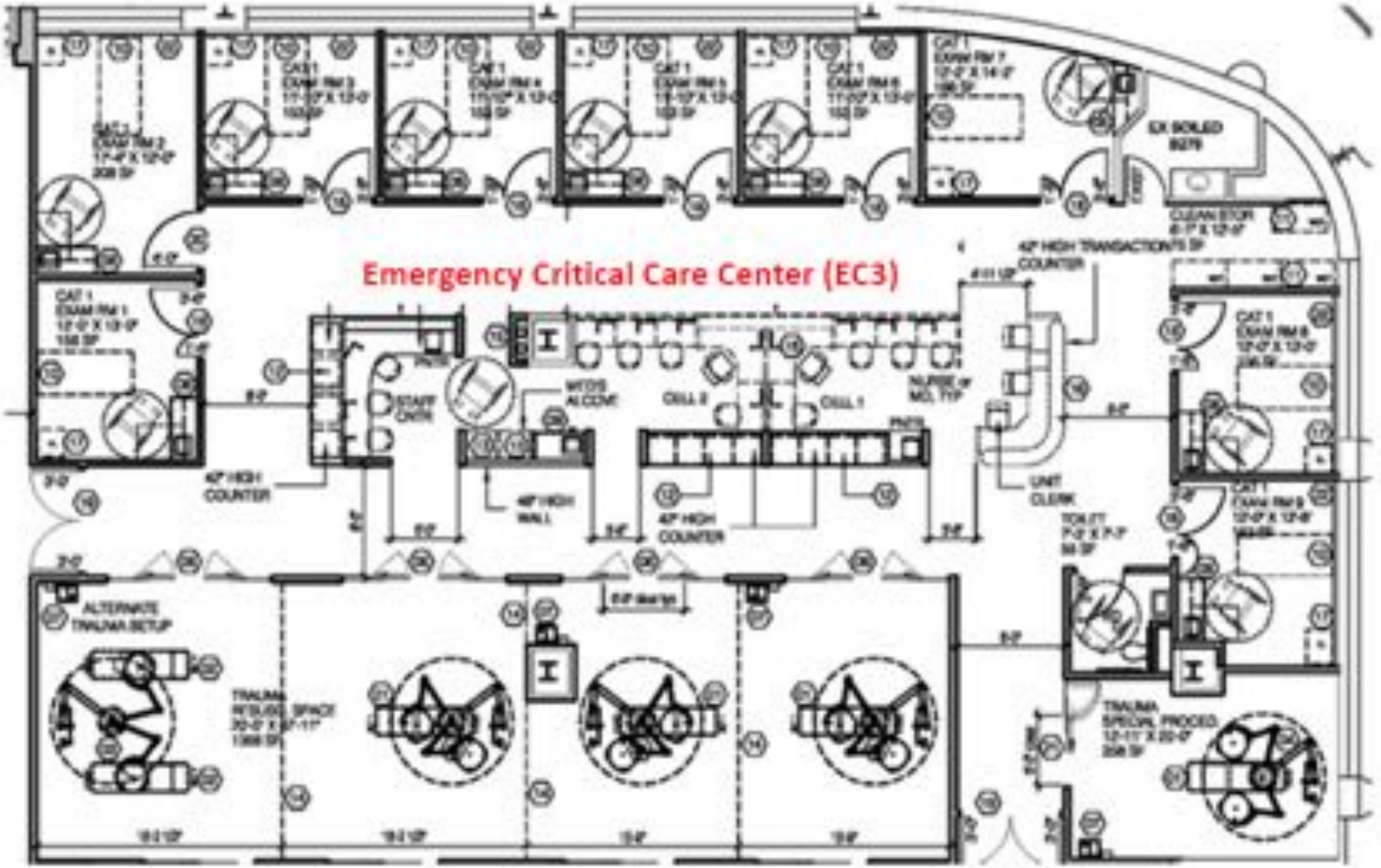
Idea Boards

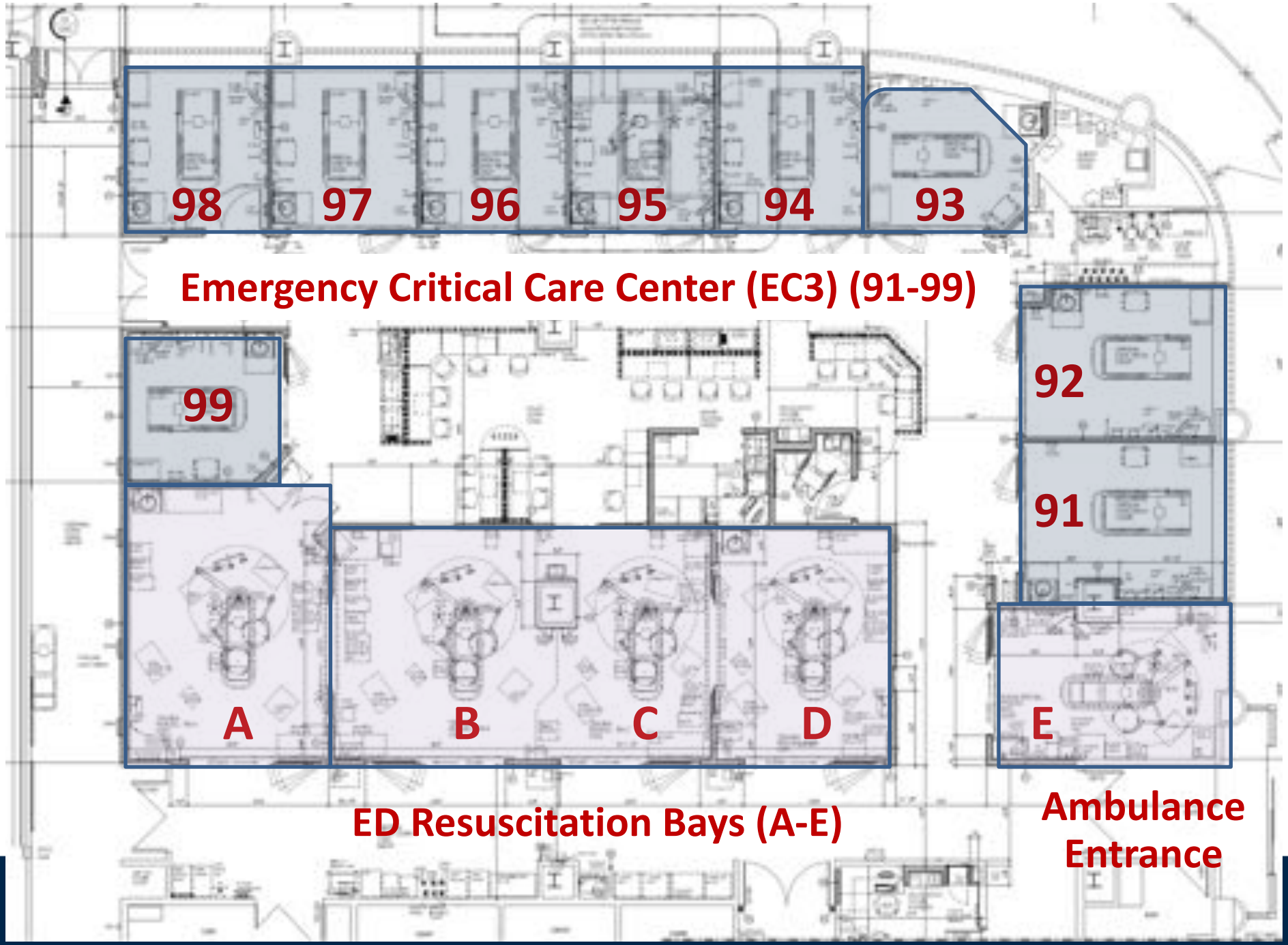
Idea Boards



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)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Emergency Critical Care Center (EC3) (91-99)
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ED Resuscitation Bays (A-E)
Ambulance Entrance

Bring in the Muscle…
September 2014


STOP


Titleist

Implementation Plan


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?)
Analysis (What are the root causes of the problem?)
Current Situation (Where are we now?)
Future State (What are the proposed countermeasures?)
Goal (Where do we want to be?)
Outcome Measures

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

Grand opening February 16, 2015

LEAN DESIGN FEATURES

Before – 3 bed Resuscitation Bay

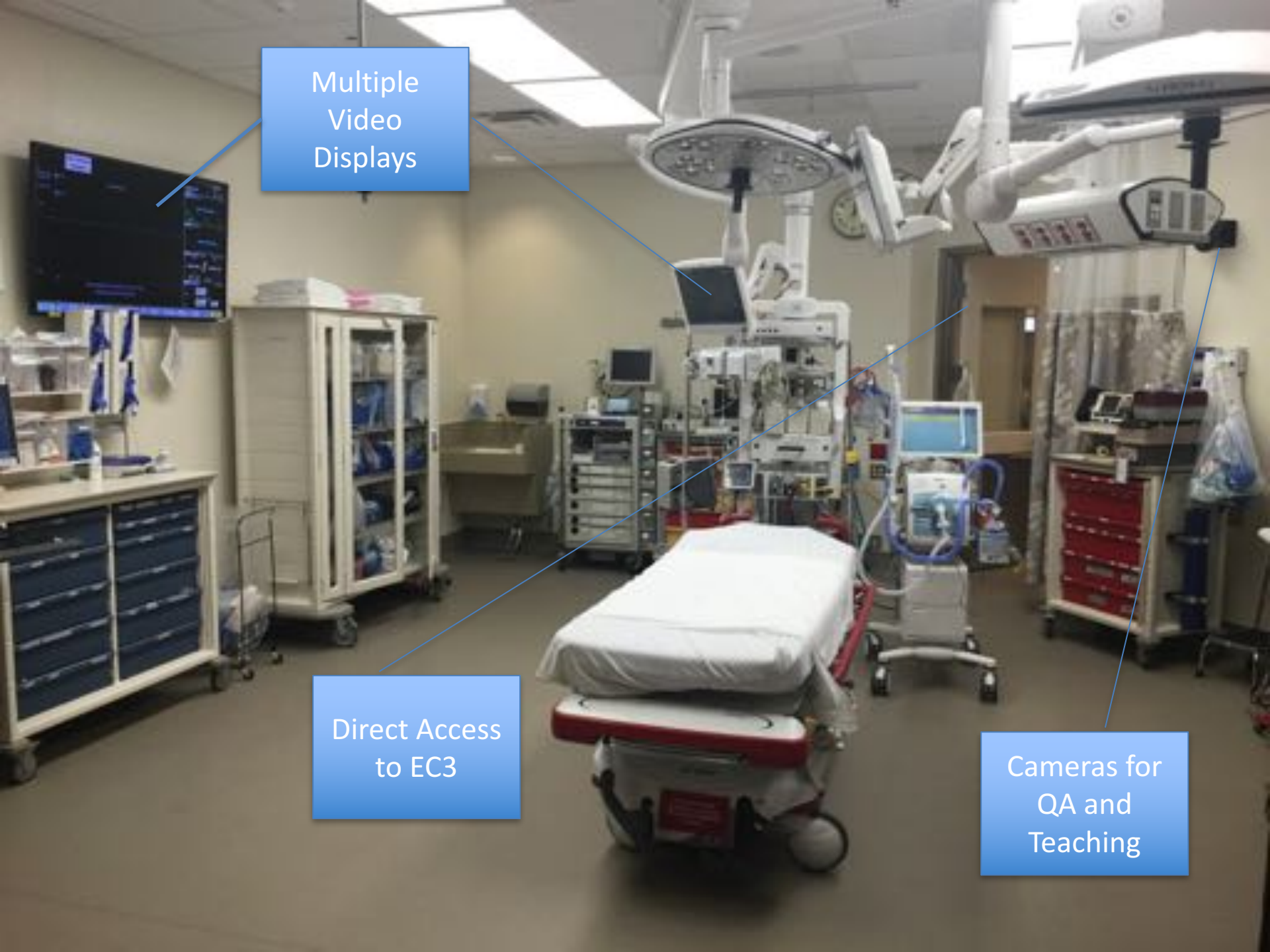
- Cold, CAT scan in zone
- No crowd control
- Patients and families not in ideal environment at their greatest time of need.

Old Resus Bay

Cluttered, old, poorly designed boom systems.

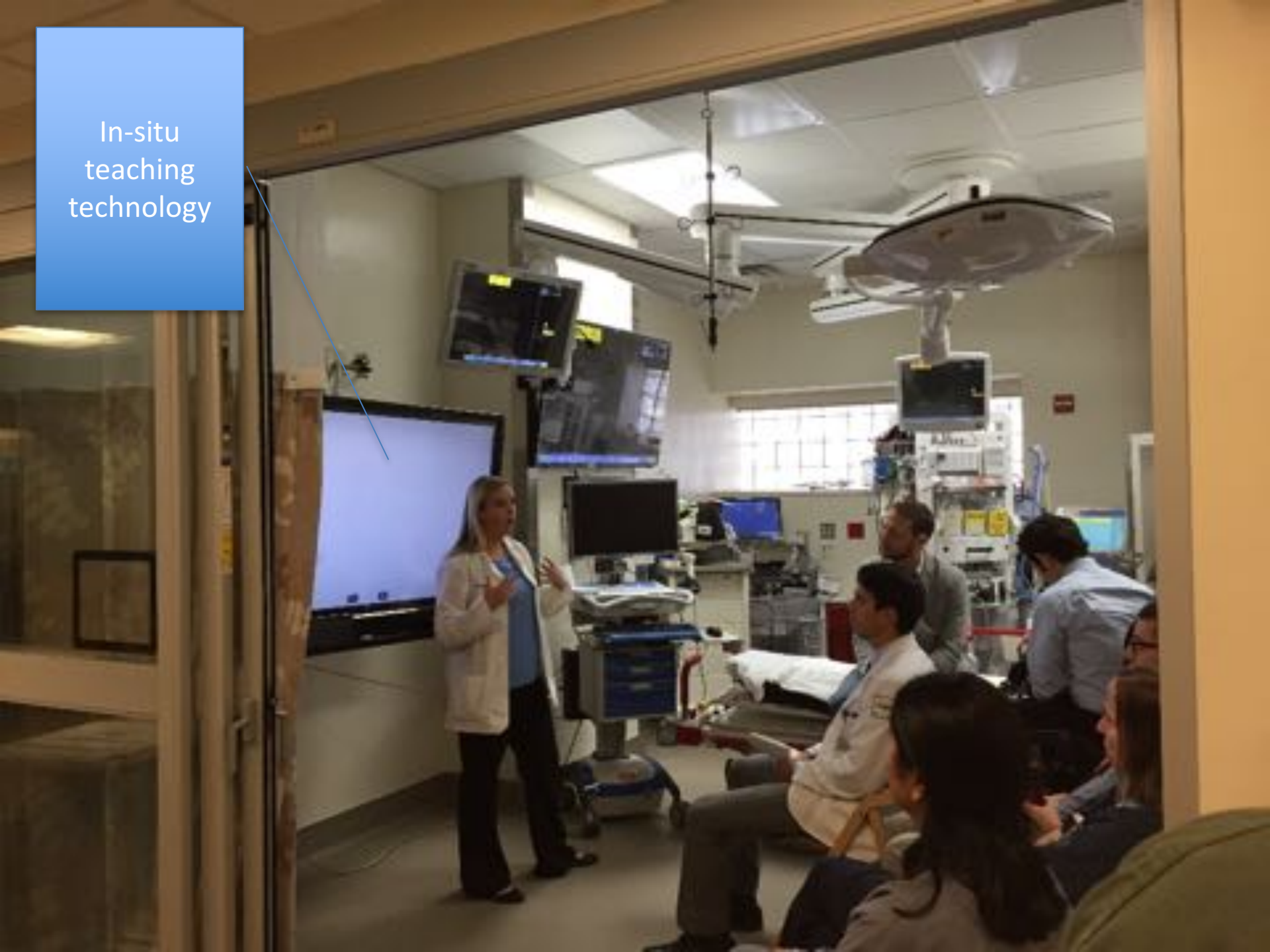
ER flea market with tons of equipment pushed to the back. Can’t find anything quickly


D
B1


Multiple Video Displays
Direct Access to EC3
Cameras for QA and Teaching

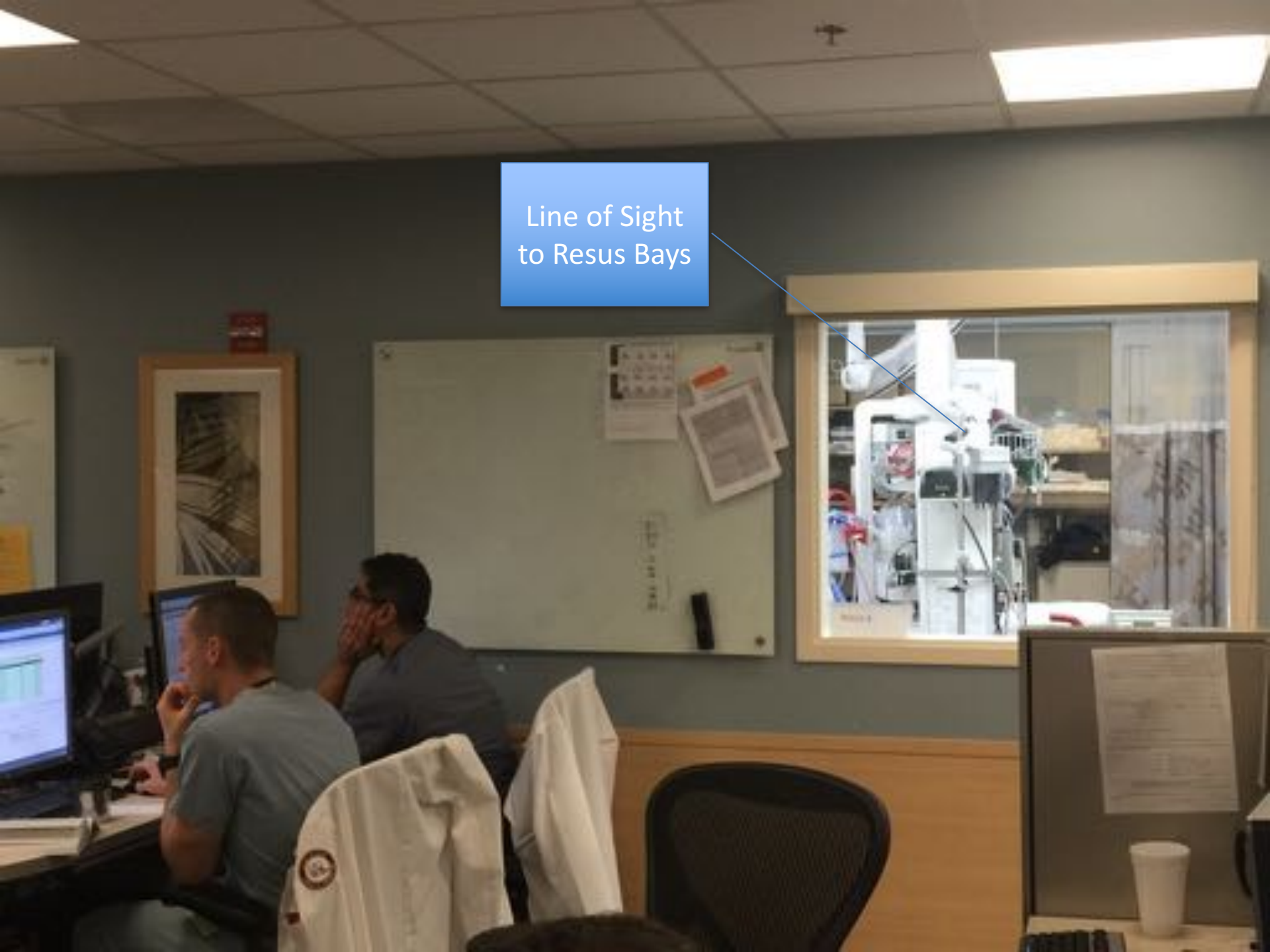

Dedicated Physician Order Entry
Dedicated Nurse Charting Station


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

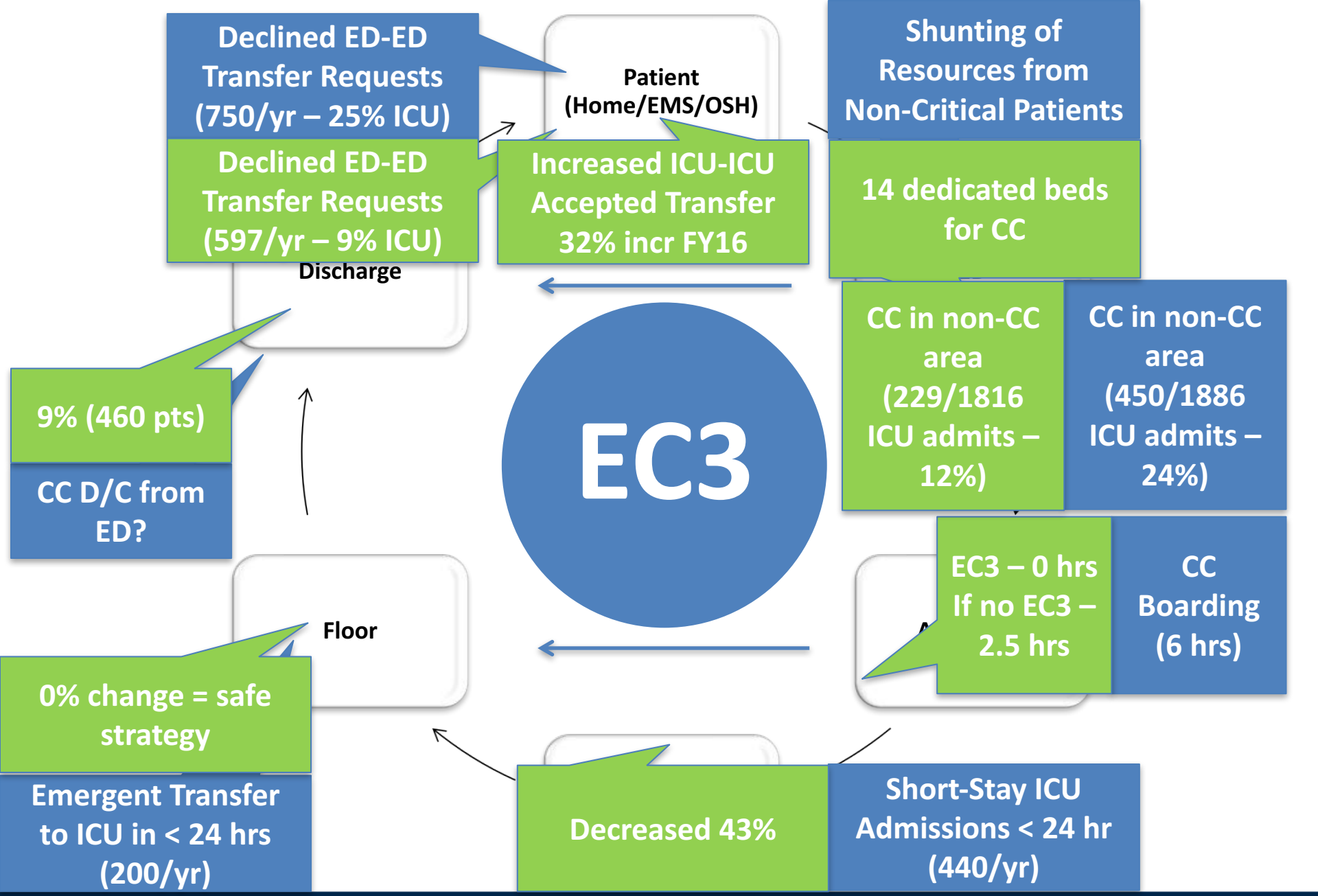

Line of Sight
to Resus Bays


Open Line of Sight Across Unit


Negative Pressure
Bariatric Lifts
HOB Clear
Ambient Light
Dialysis Boxes


Family Zone
Patient Zone
Caregiver Zone
Hill-Rom

EARLY RESULTS AND TARGET METRICS


Declined ED-ED Transfer Requests (750/yr – 25% ICU)
Patient (Home/EMS/OSH)
Shunting of Resources from Non-Critical Patients
Declined ED-ED Transfer Requests (597/yr – 9% ICU)
Increased ICU-ICU Accepted Transfer 32% incr FY16
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%)
9% (460 pts)
CC D/C from ED?
EC3
EC3 – 0 hrs If no EC3 – 2.5 hrs
CC Boarding (6 hrs)
Floor
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

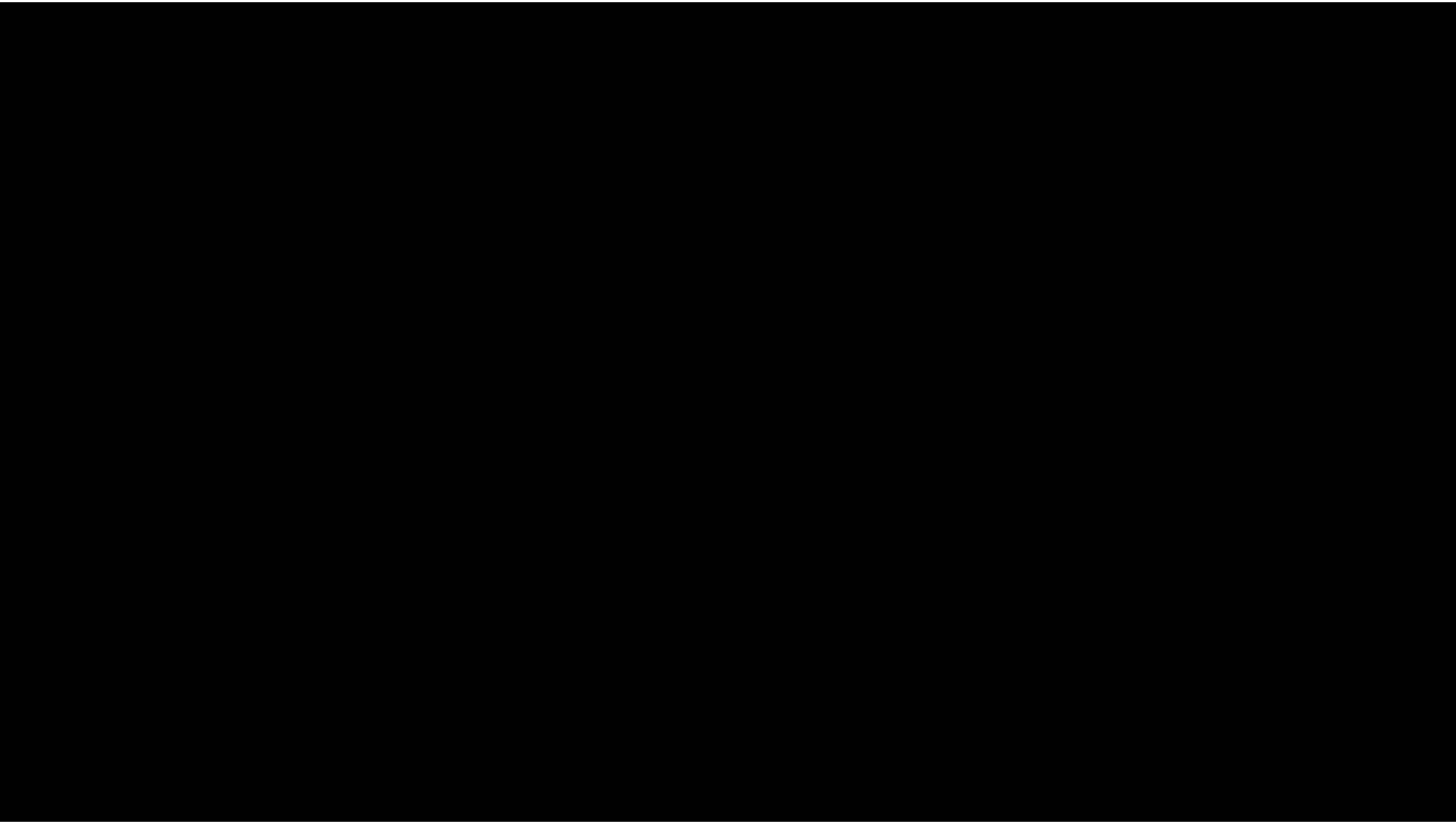
- Improve access to timely critical care by enhancing the capacity and capability to deliver high quality critical care in the Adult Emergency Department at the University of Michigan.
- In reality, the model has completely changed the ED & ICU healthcare delivery paradigm

Thank you


Joyce and Don Massey
Family Foundation
Emergency Critical Care Center

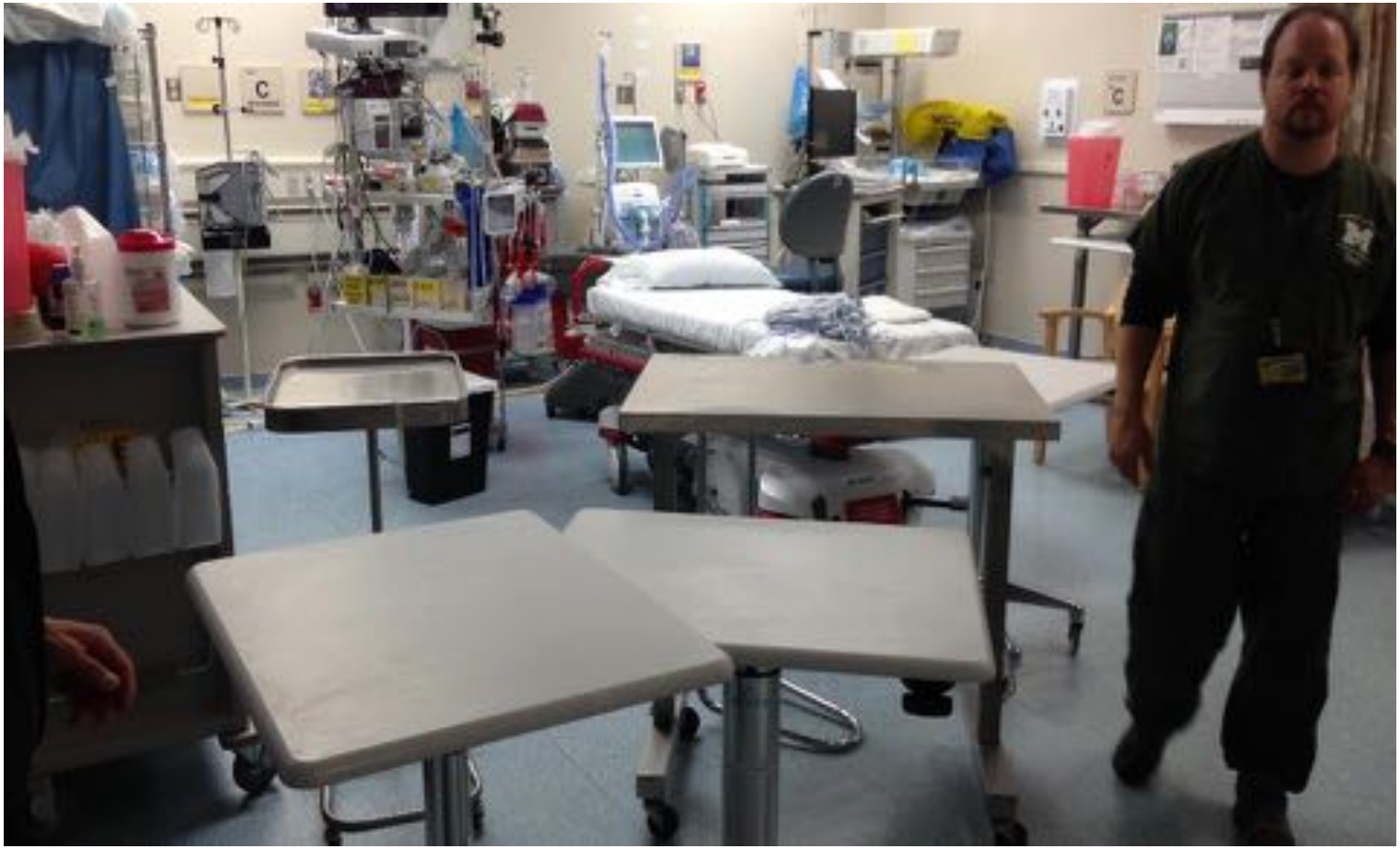
Questions?


EMERGENCY CARE
INNOVATION OF THE YEAR AWARD
Honorable Mention Presented to
University of Michigan Health System
Emergency Critical Care Center
Submitted by Benjamin S. Bassin, M.D.
October 15, 2016
SCHUMACHER



RAPID IMPROVEMENT EVENTS (KAIZEN)

Excess Equipment



Procedural Line Carts

New Line Cart

Airway cart redesign

Airway cart redesign

Applied Principles

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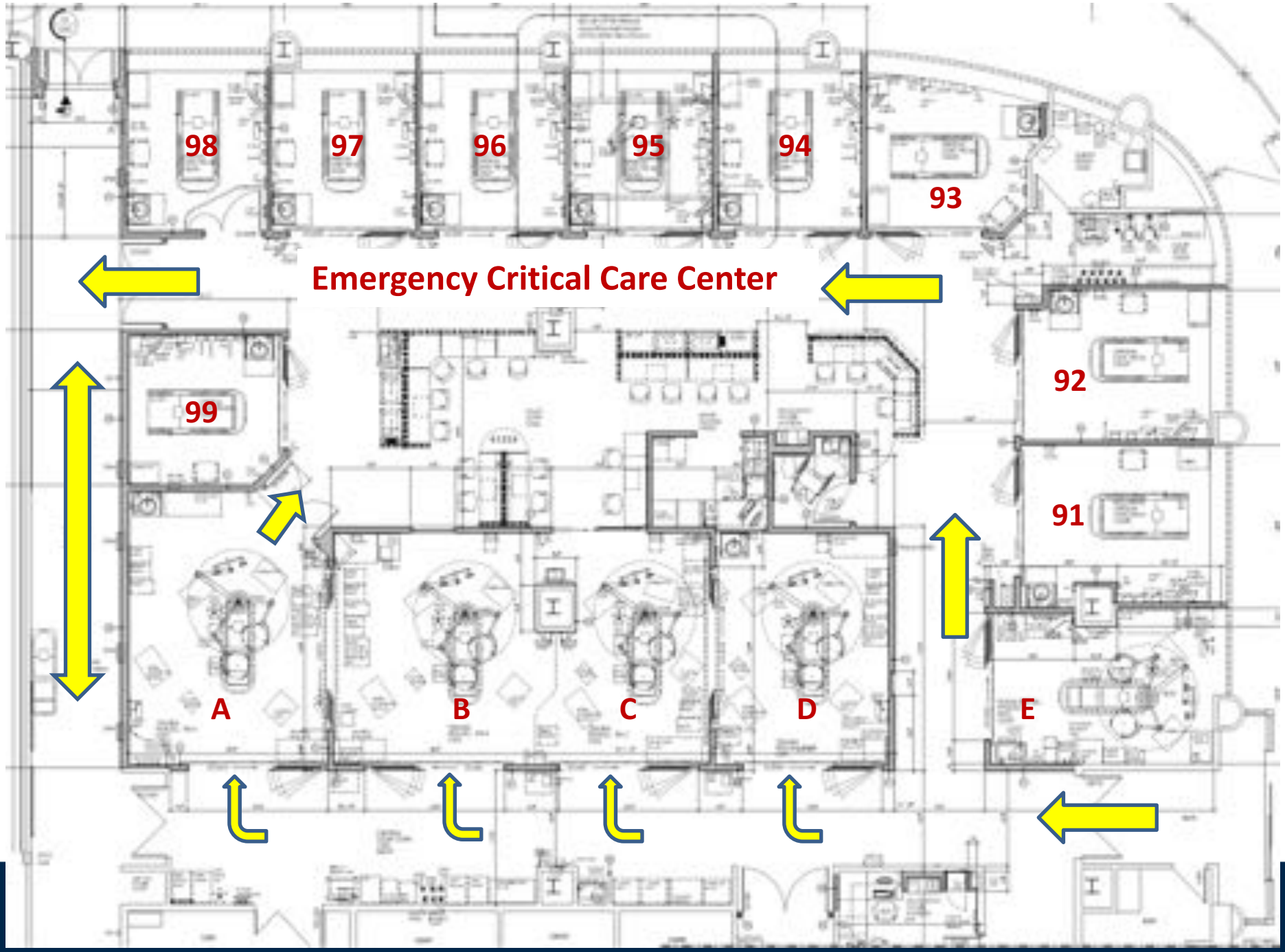
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Emergency Critical Care Center
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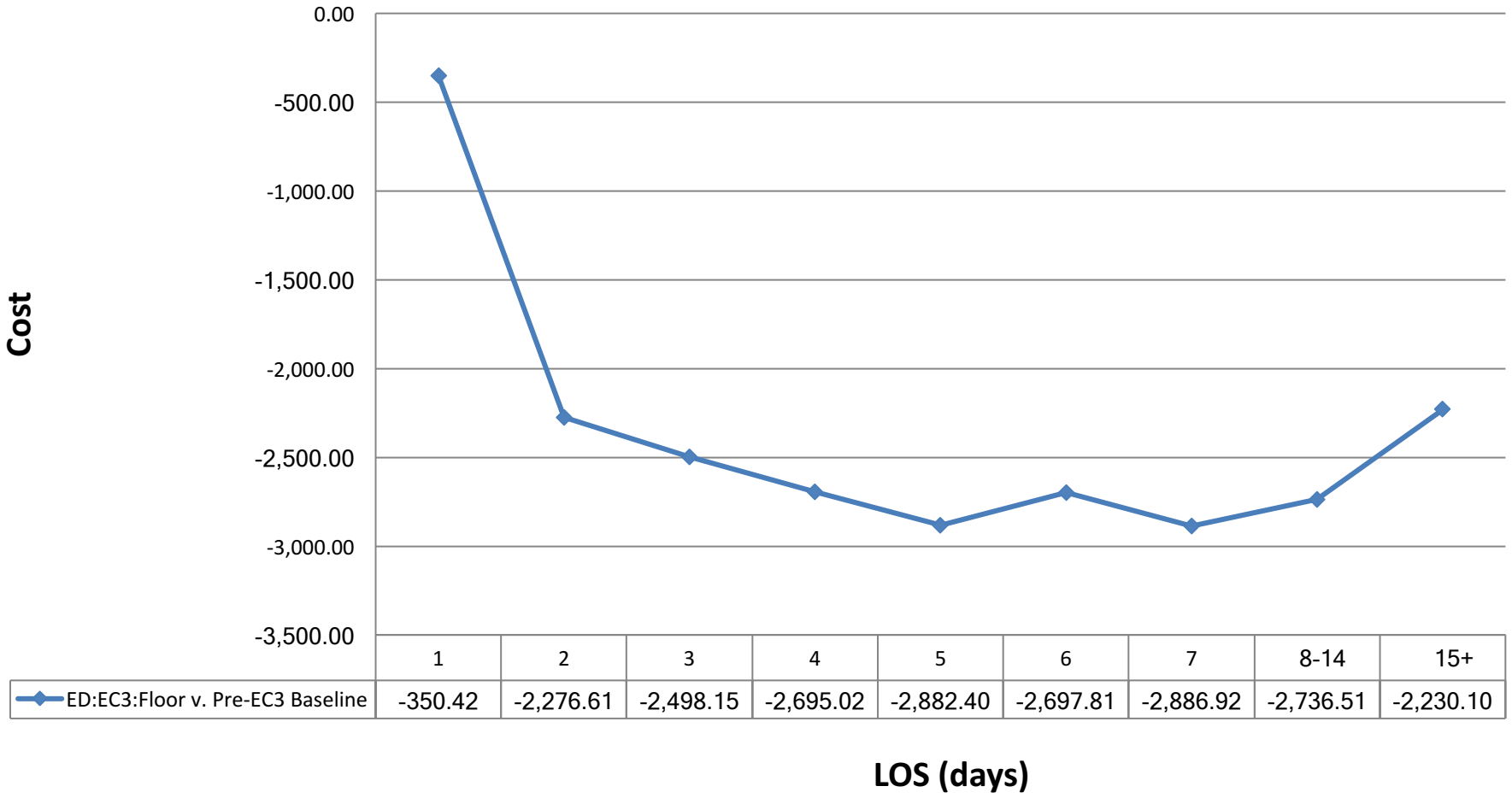
ED:EC3:Floor v. Pre-EC3 Baseline

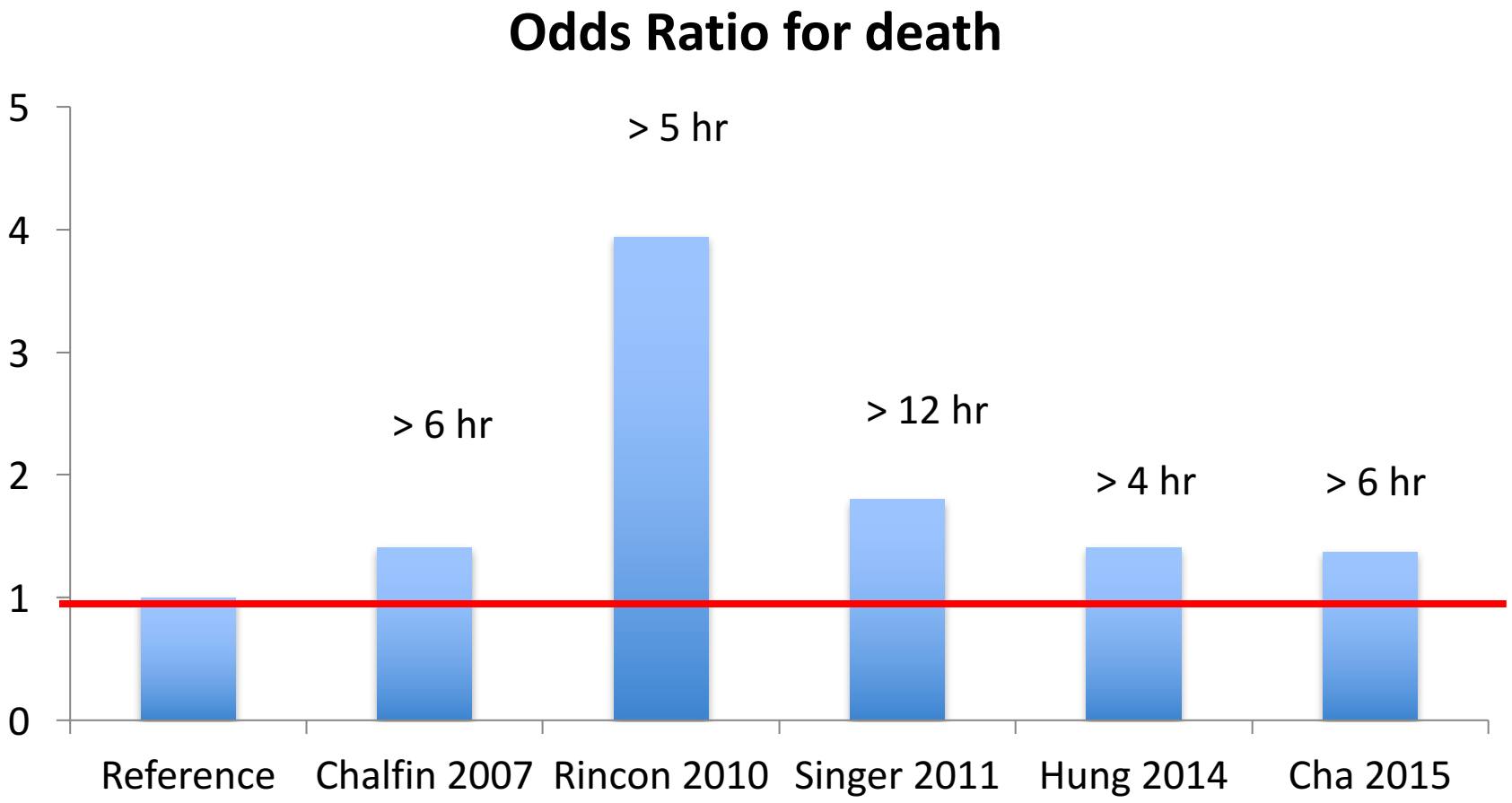


	1	2	3	4	5	6	7	8-14	15+
ED:EC3:Floor v. Pre-EC3 Baseline	-350.42	-2,276.61	-2,498.15	-2,695.02	-2,882.40	-2,697.81	-2,886.92	-2,736.51	-2,230.10

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 ≤ 24 hrs	~440/yr
• Floor to ICU Txfr ≤ 24 hrs	~200/yr

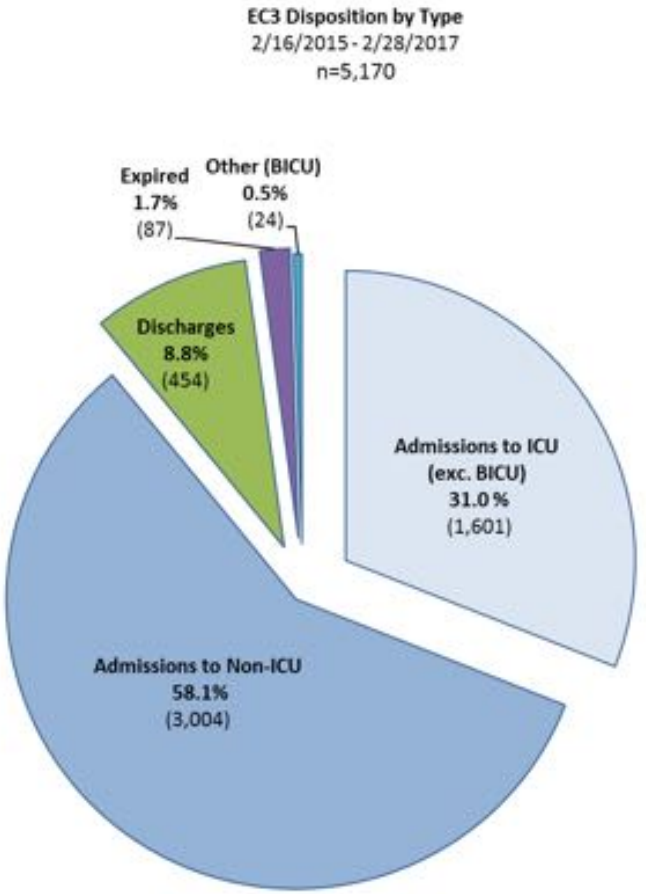
Time in ED waiting for ICU bed…



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 *Multiple per patient possible*	**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 ≤ 24 hrs after admit to ward	Rate
Pre-EC3	51,451	377	**0.8%**
Post-EC3	55,912	400	**0.8%**

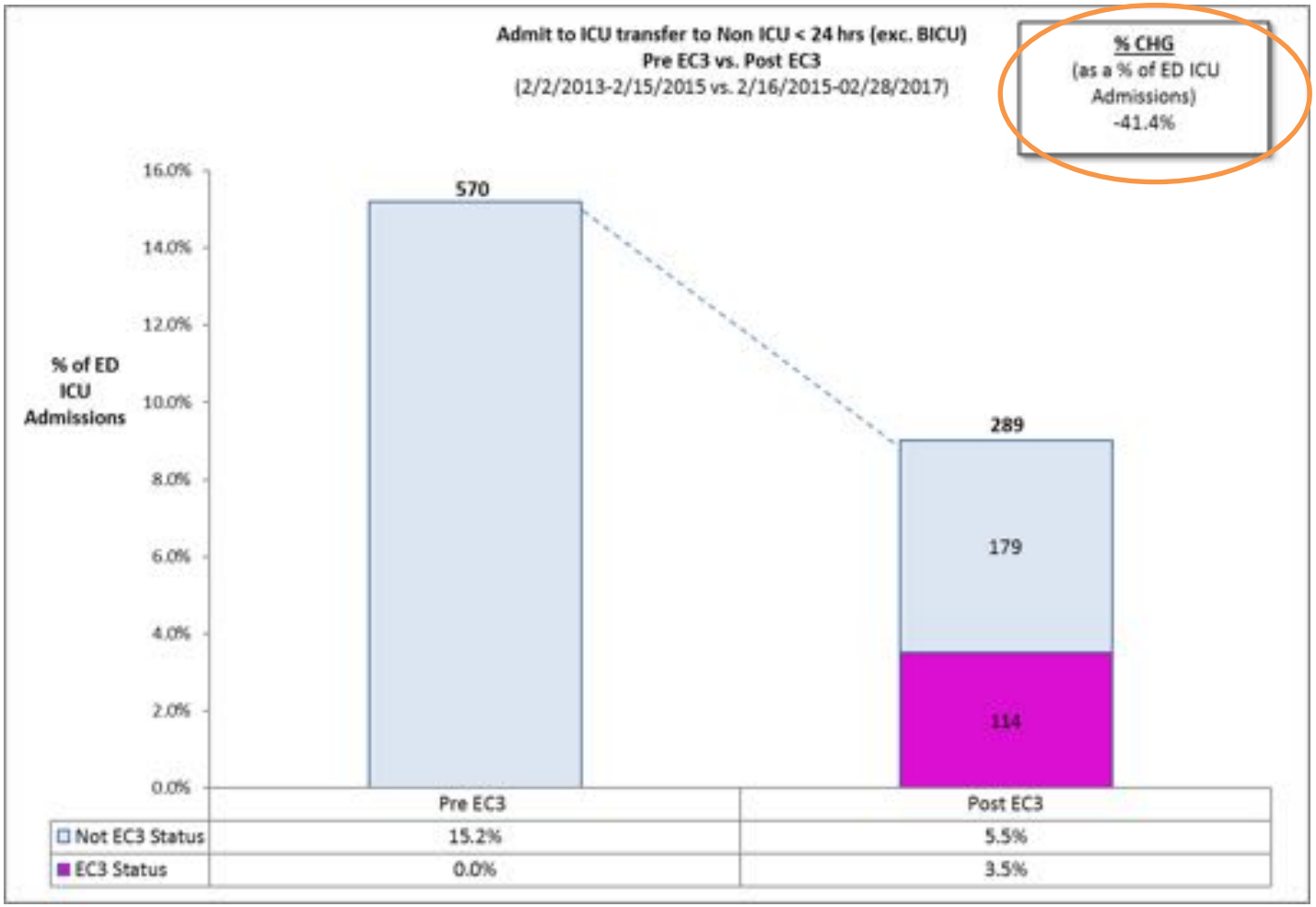
EC3 Not Associated with Increased Short Term (≤ 48 hrs) Mortality

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

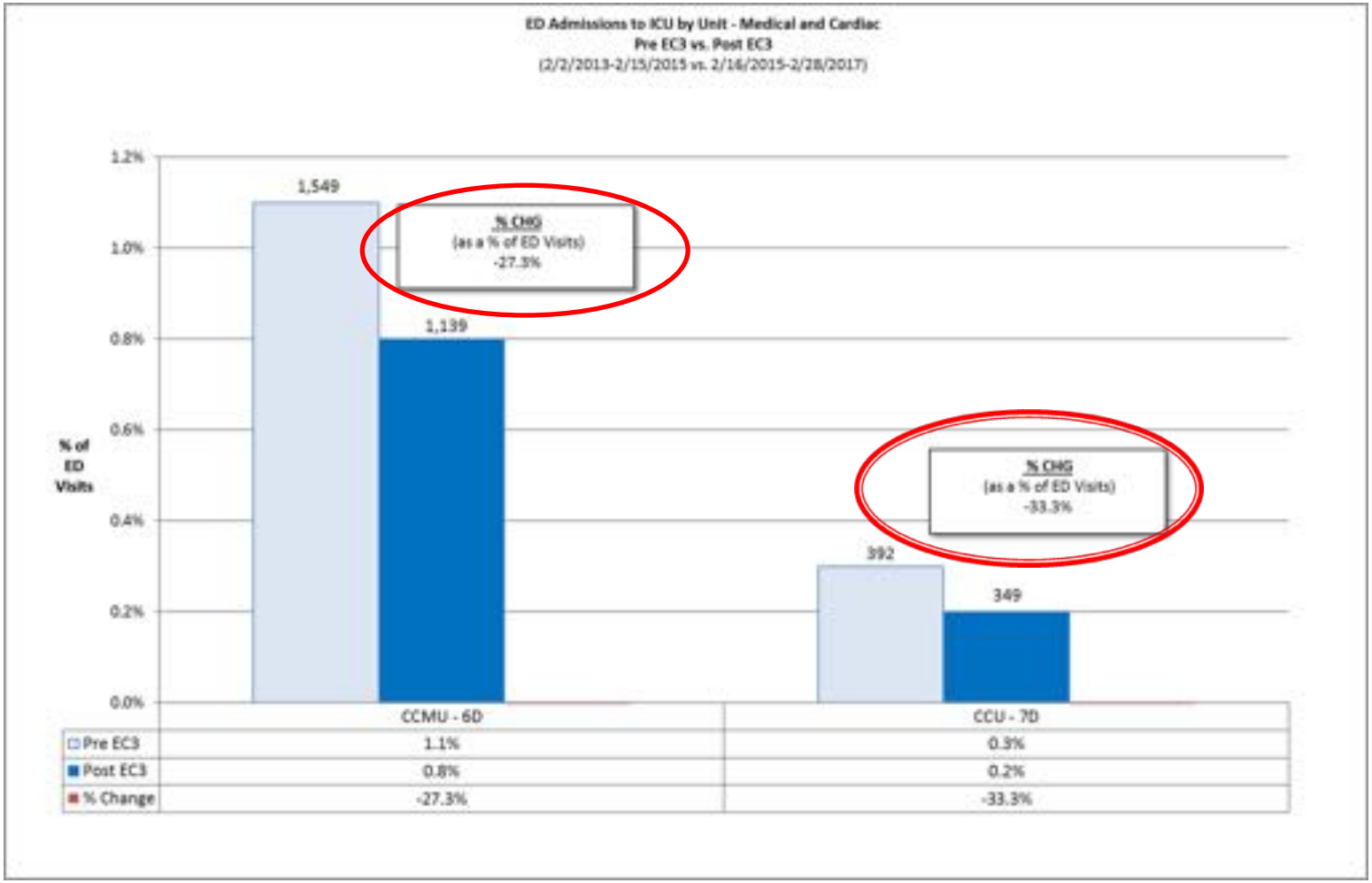
ICU Bed Days Saved

Minimum ICU Bed Days Saved[1]	**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

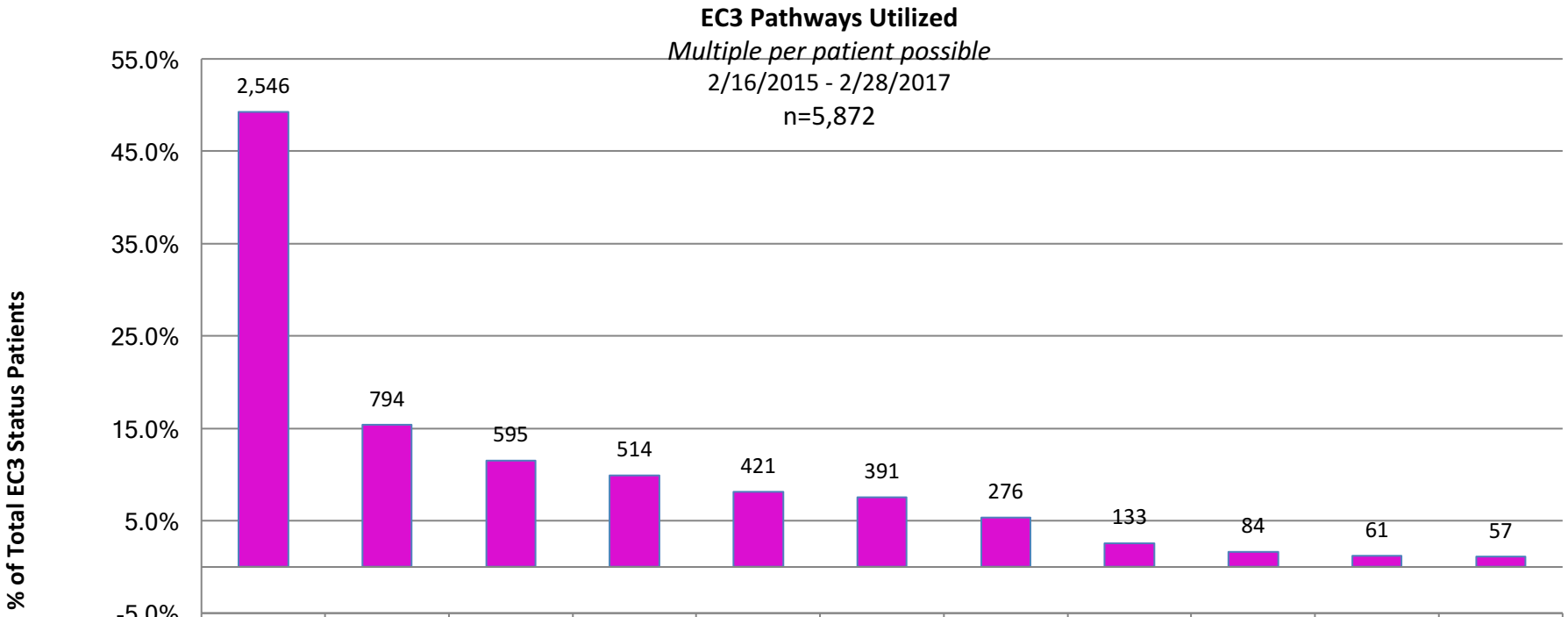
Reduction in “Short Stay” ICU Admissions



Reducing Medical ICU Admissions

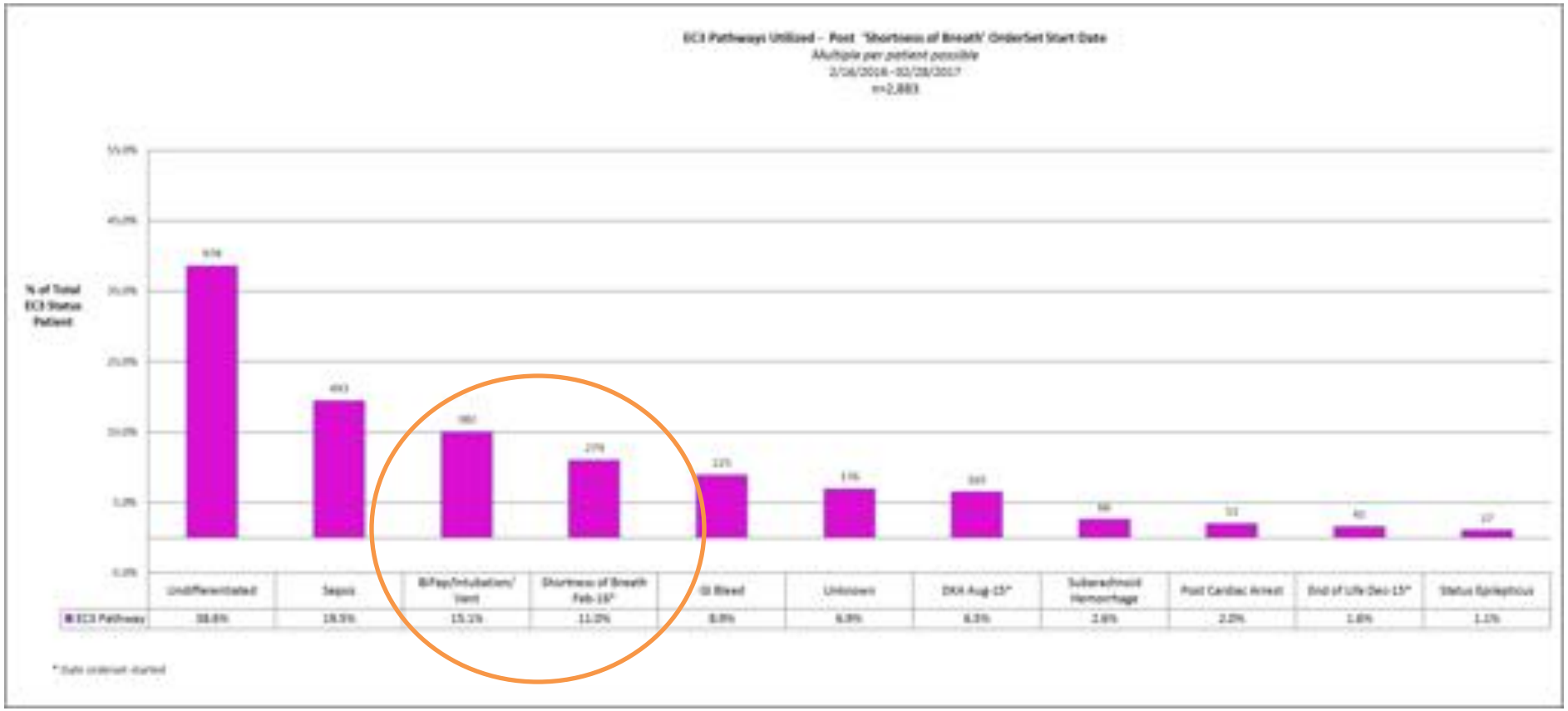


Disease Specific Order Sets

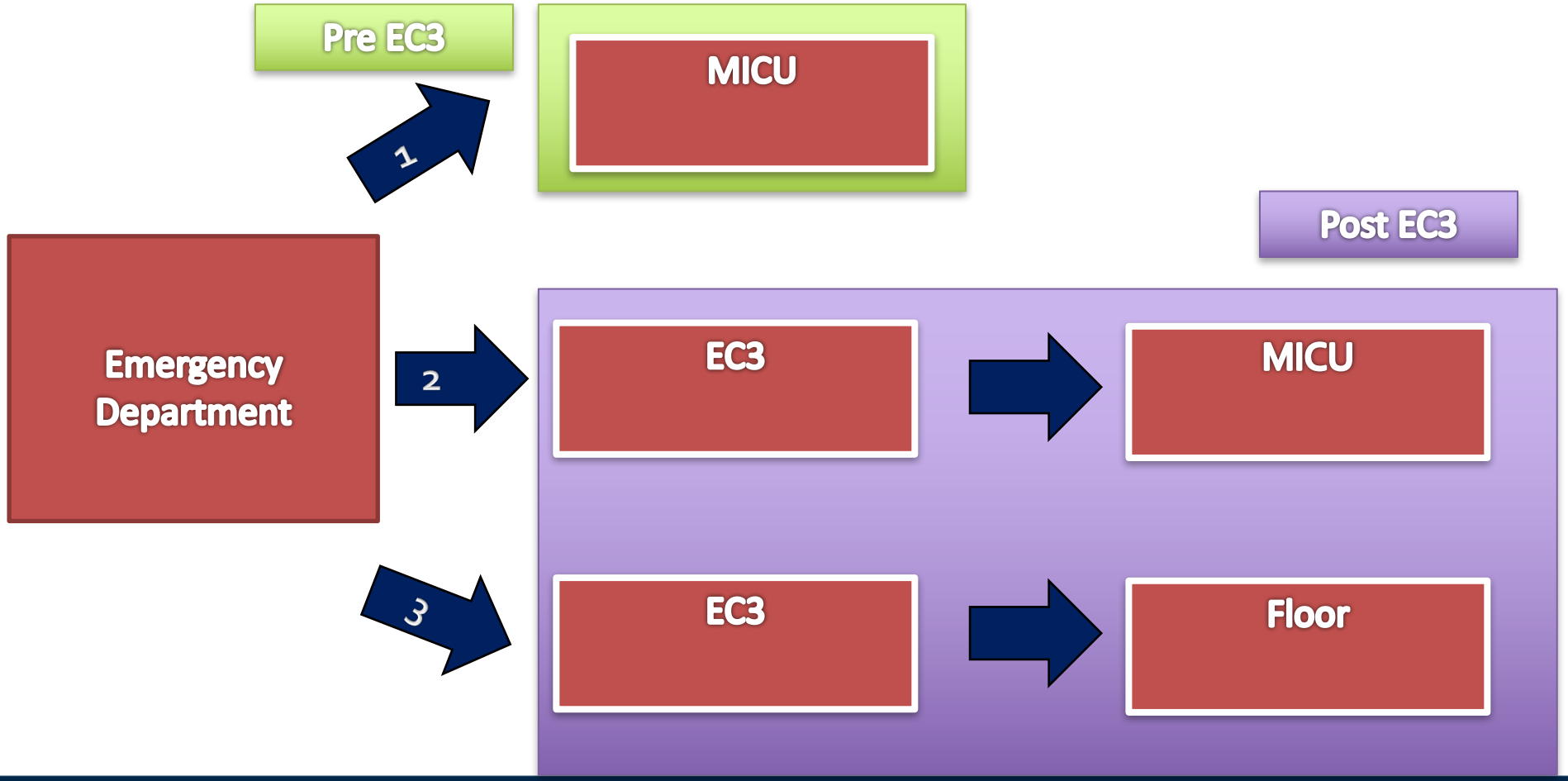


* Date orderset started

Disease Specific Order Sets



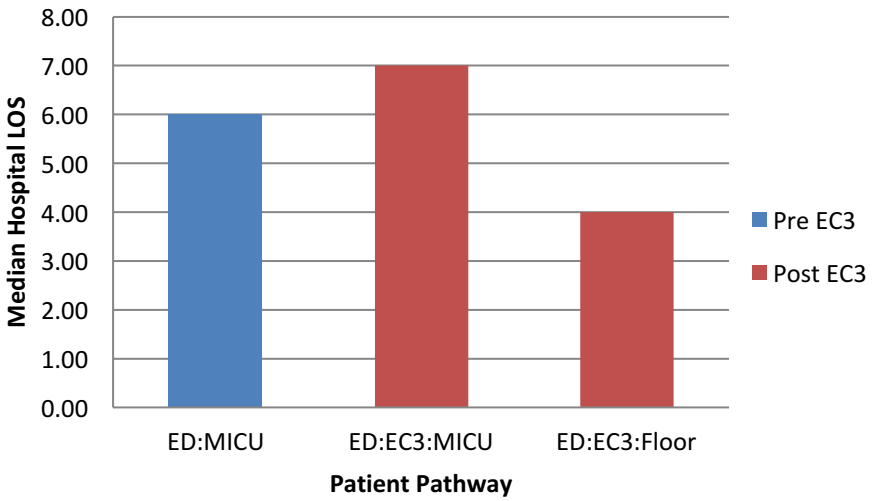
Length of Stay & Cost Analysis



Length of Stay

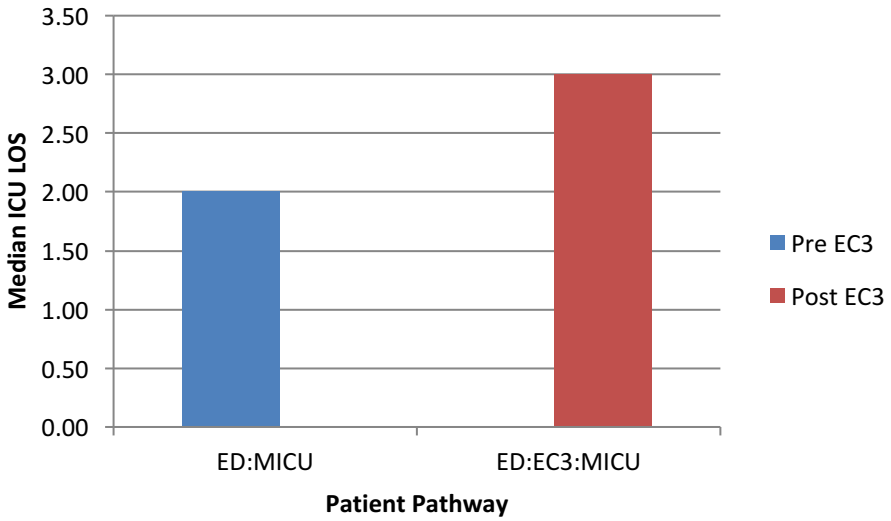
Median Hospital LOS

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

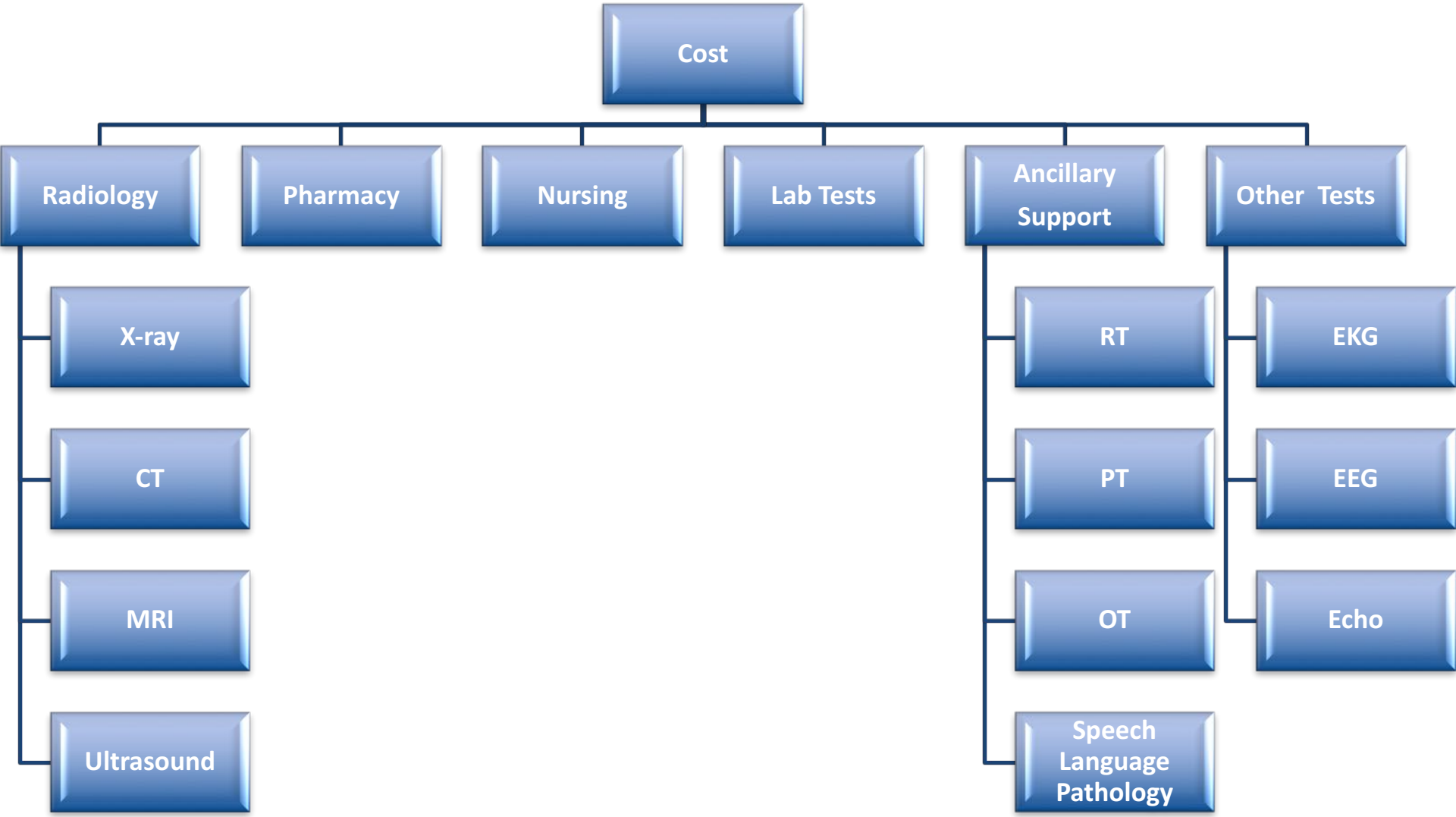


Median ICU LOS

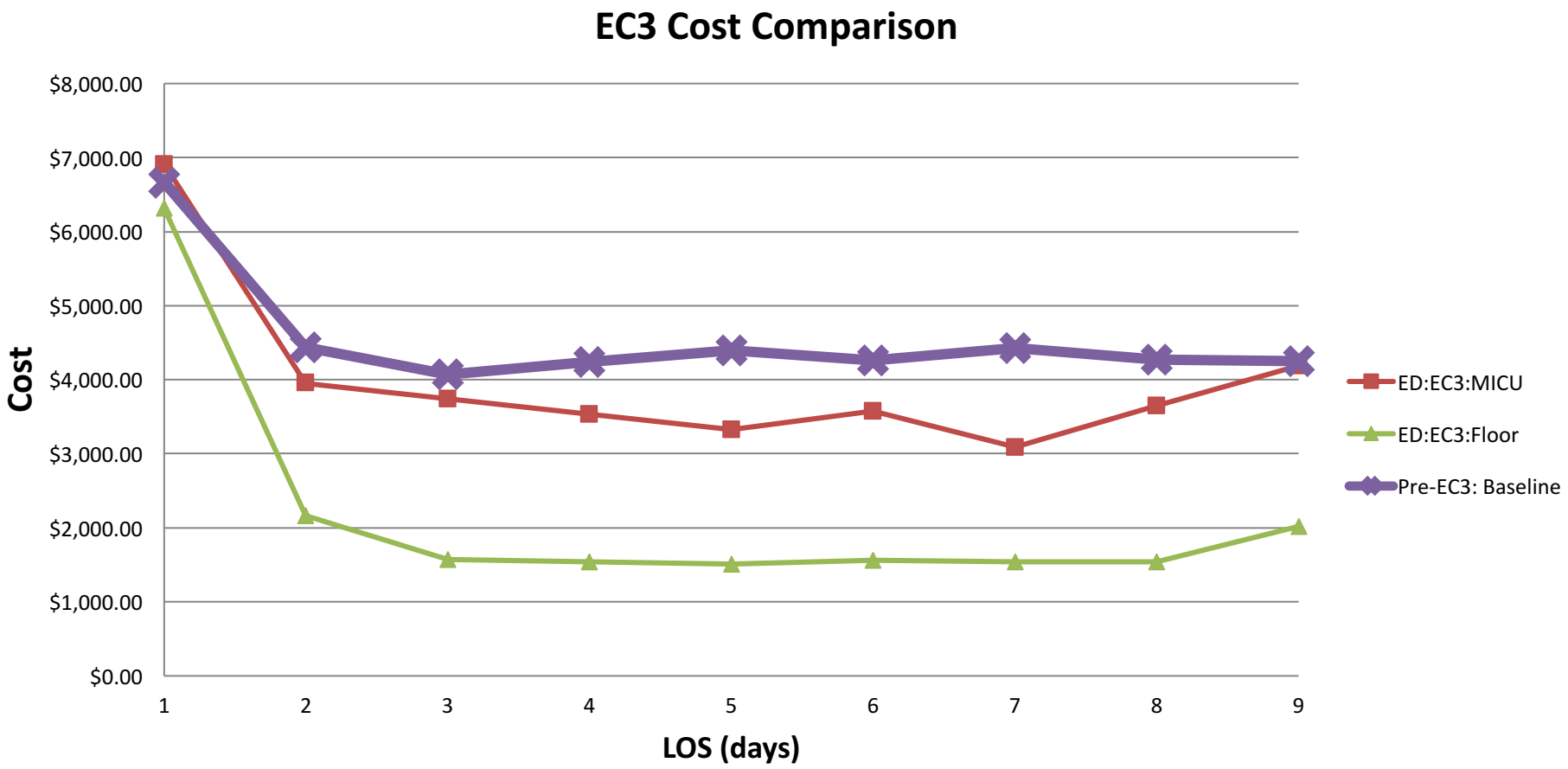
	Pre EC3	Post EC3
ED to MICU	2.00	
ED to EC3 to MICU		3.00



Cost Components

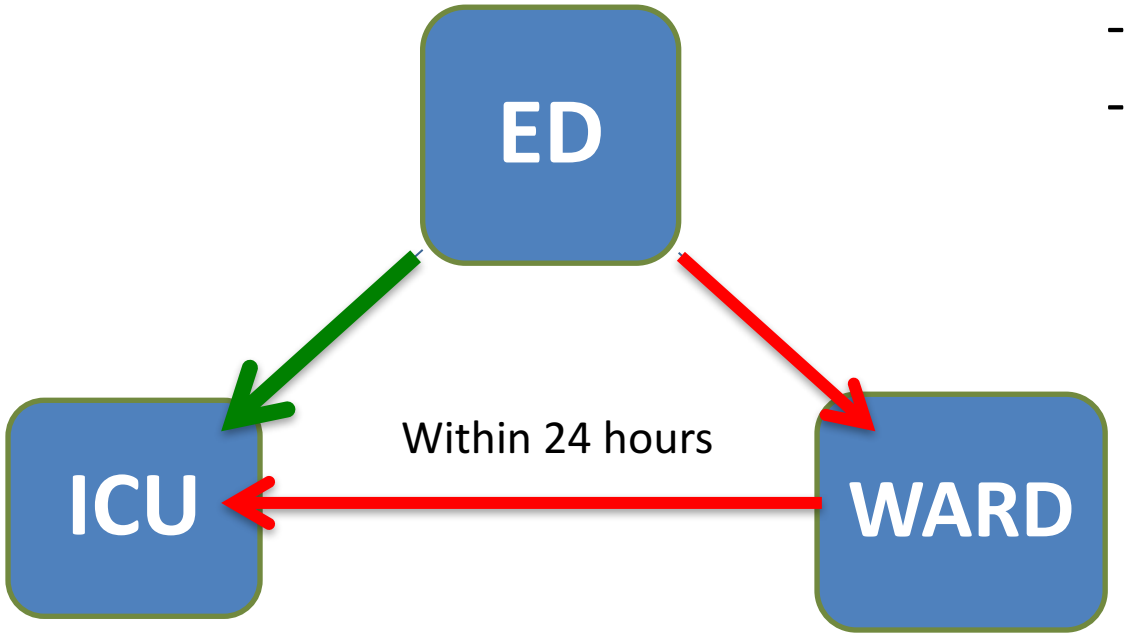


EC3 Cost Comparison



An Opportunity

WARD→ICU transfer is also associated with increased mortality



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

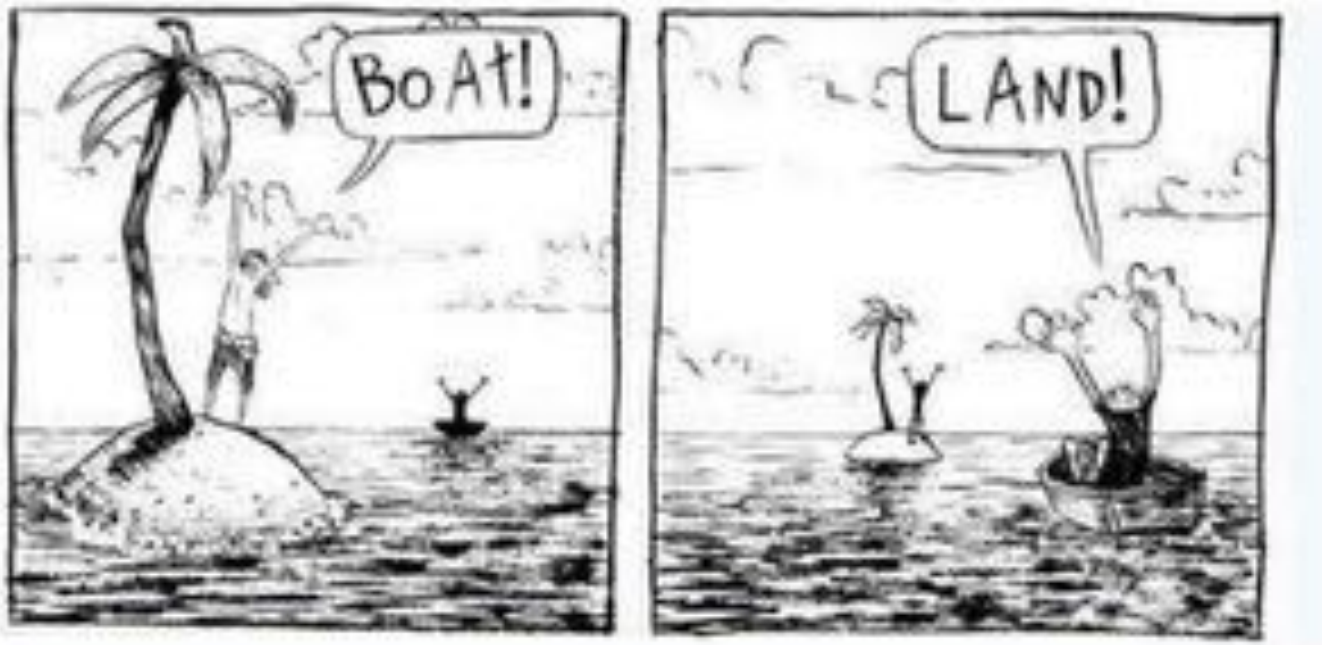
Incremental FTEs

- 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

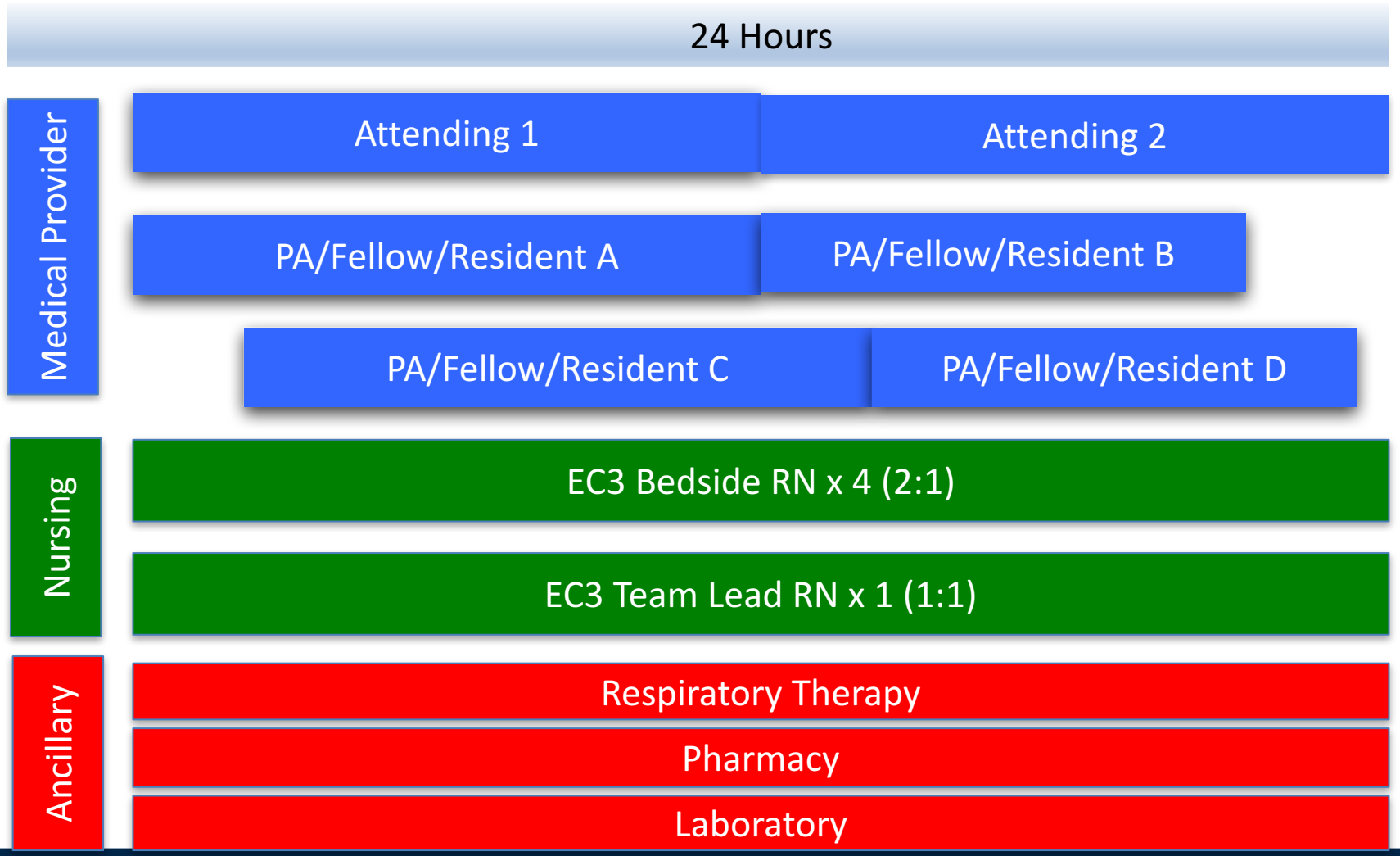


Perspective...

Roadmap

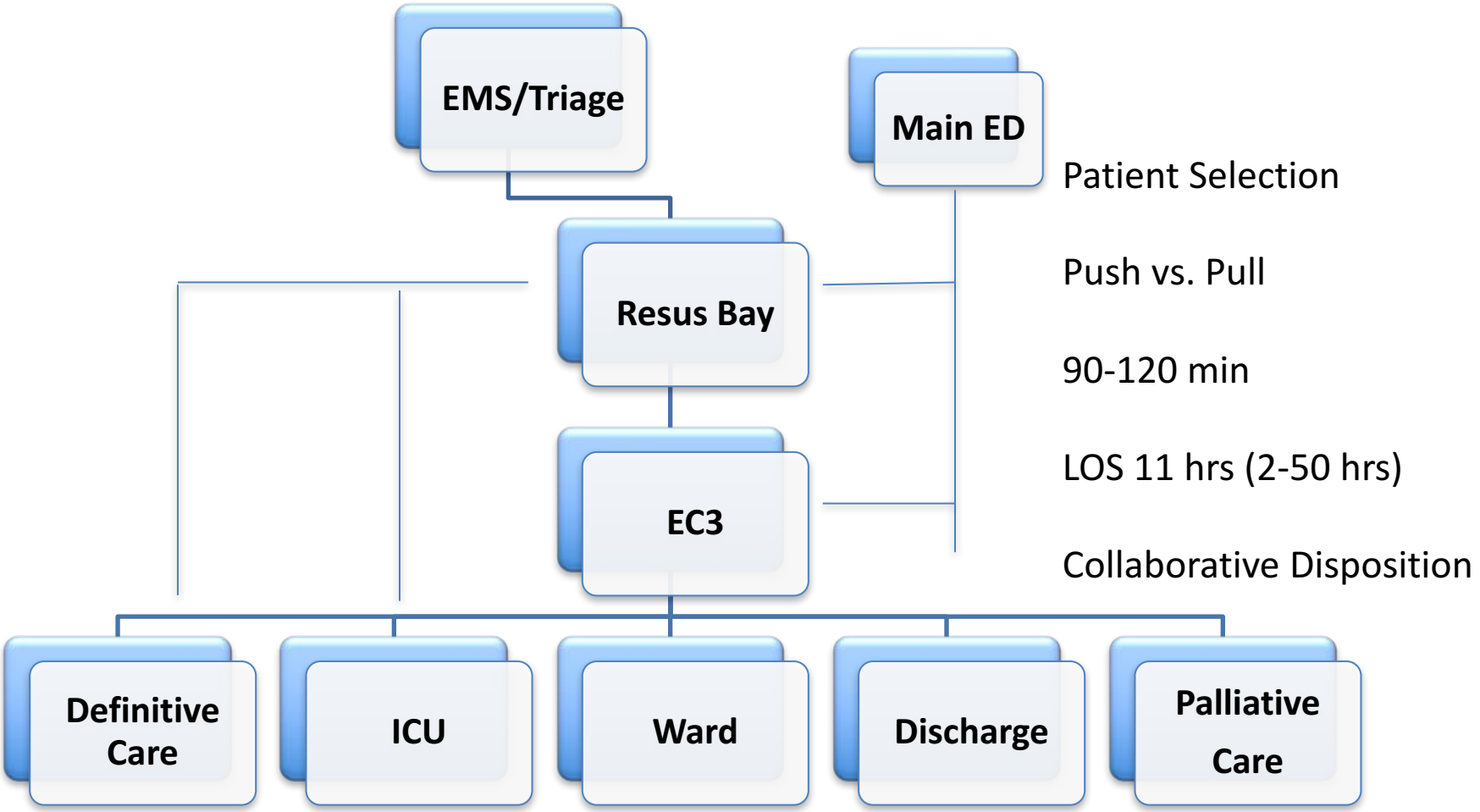
- Internal audit – Needs based assessment of current state
- Critical Care Assessment
  - Siloed
  - Specific space for specialized care
- Emergency Medicine Assessment
  - Emergency Critical Care emerging specialty (care/education/research)
  - Current staffing model
  - Current physical plant

Staffing Model



Implementation Plan

EC3: Logistics and Patient Flow



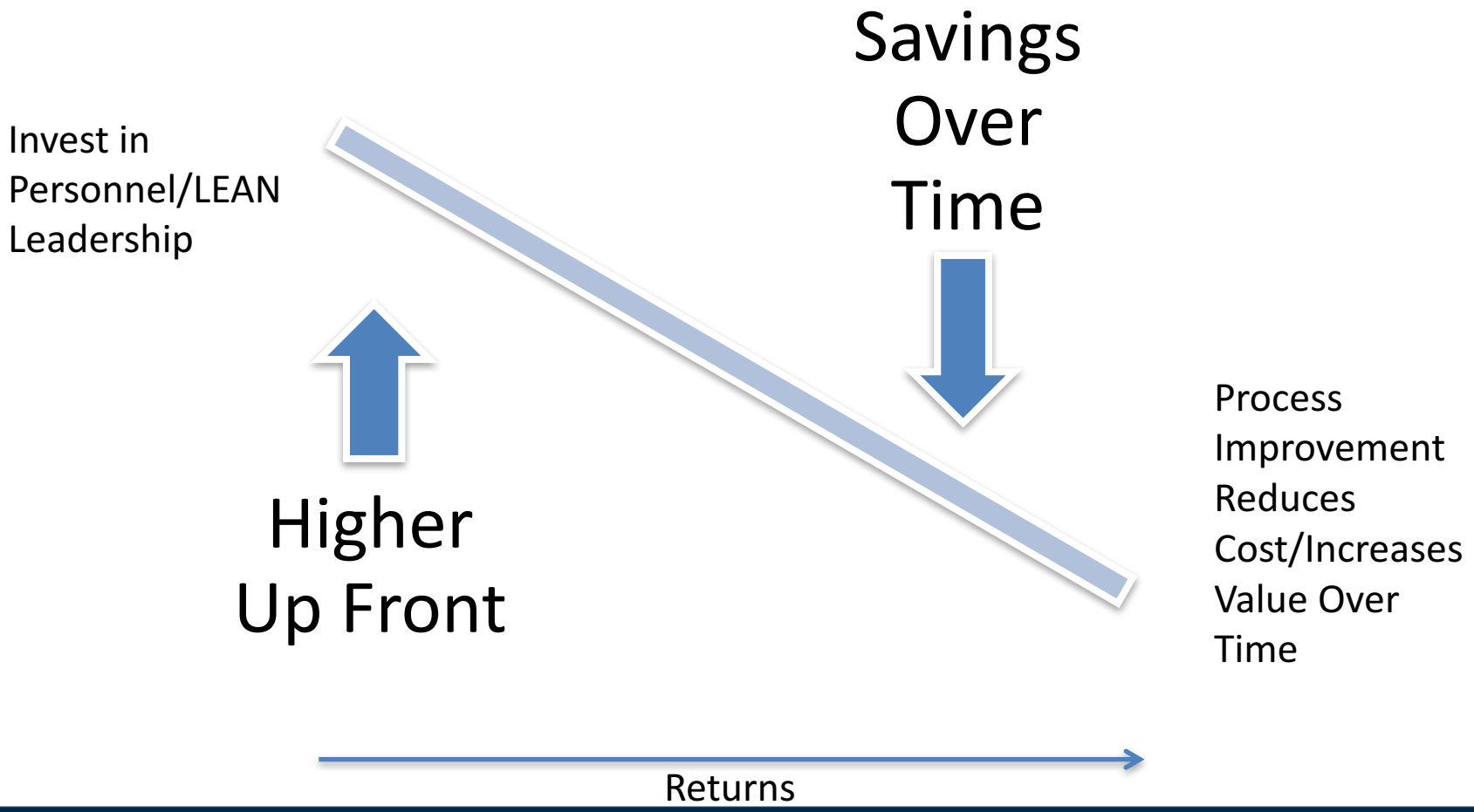
Ribbon Cutting – Feb 2015

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

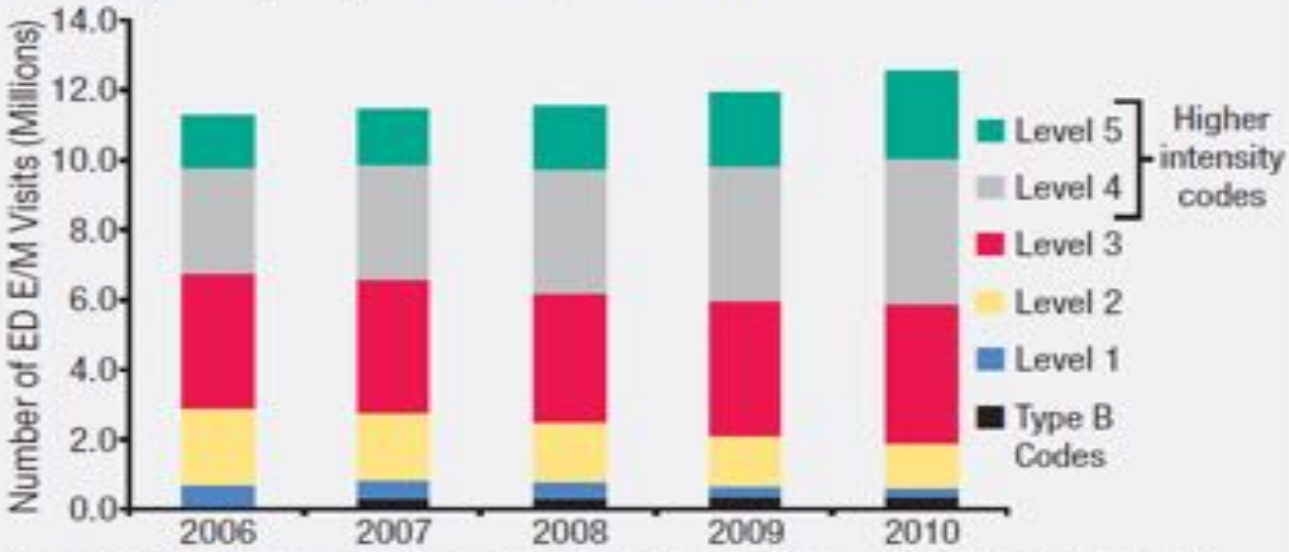
Cost Impact of LEAN



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

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


HermanMiller


SKYTRON


SPECTRUM HEALTH


ThedaCare


stryker


Hill-Rom


STORZ
KARL STORZ — ENDOSKOPE


SKYTRON


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

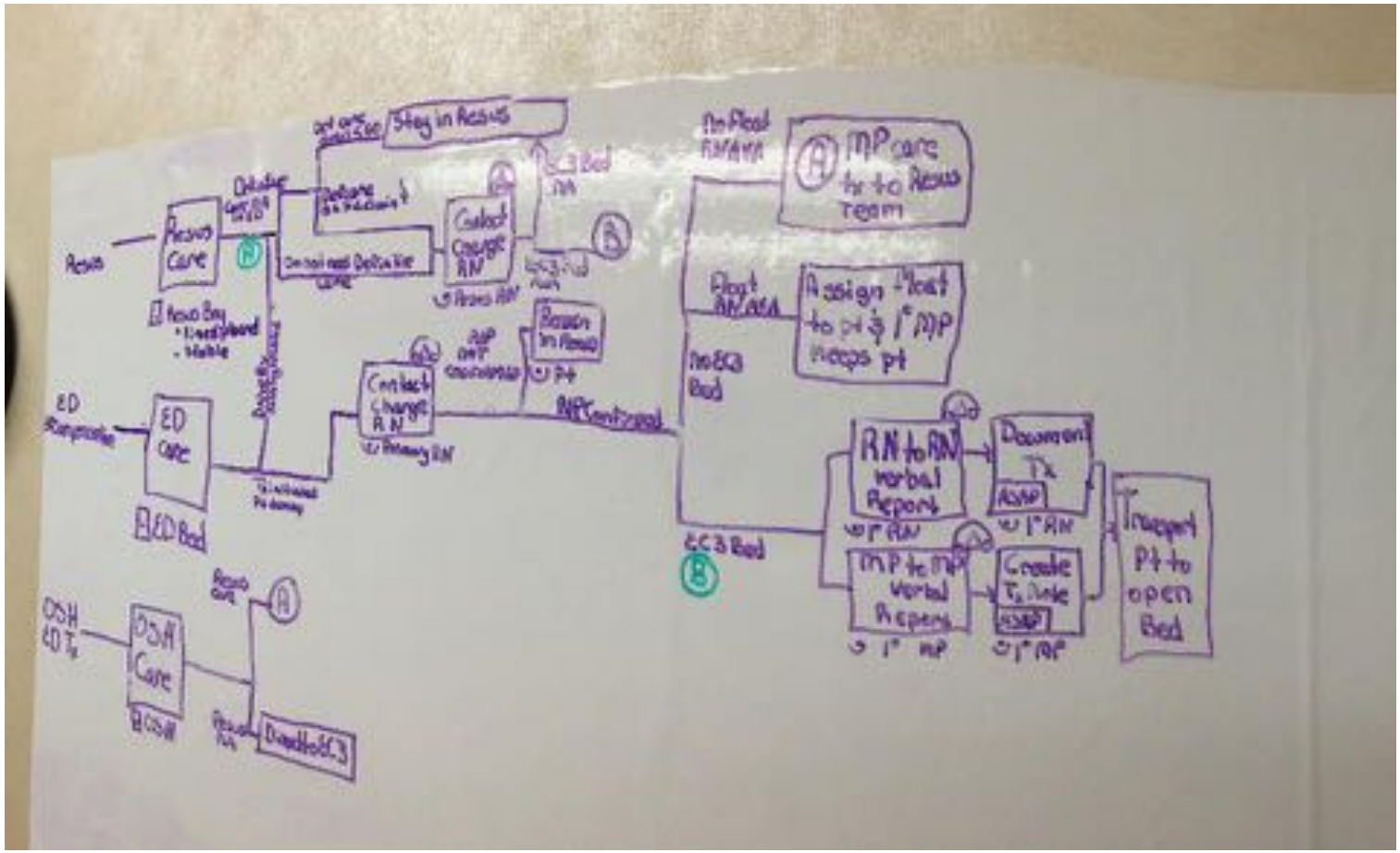
Golden Tickets

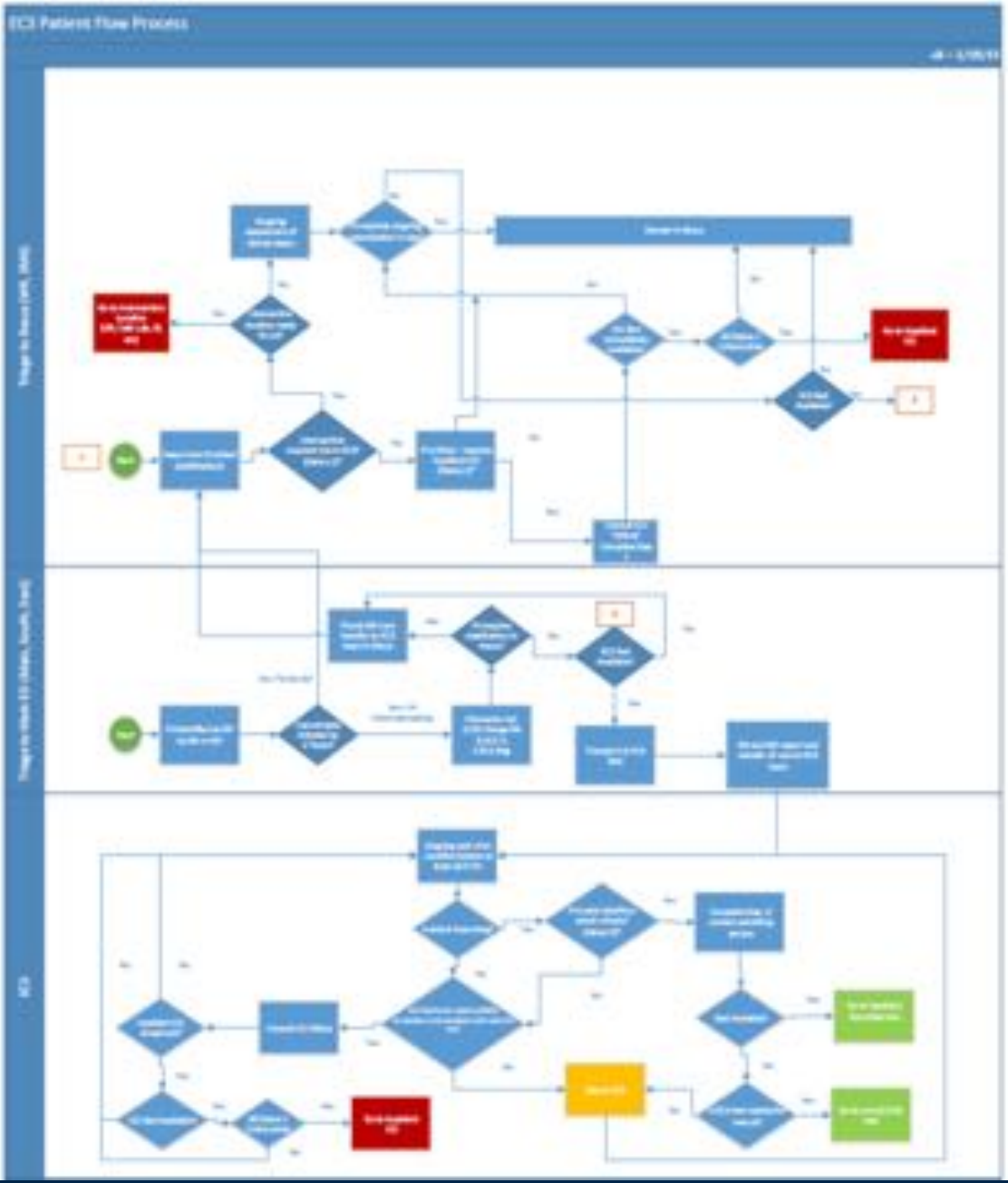
Lessons Learned

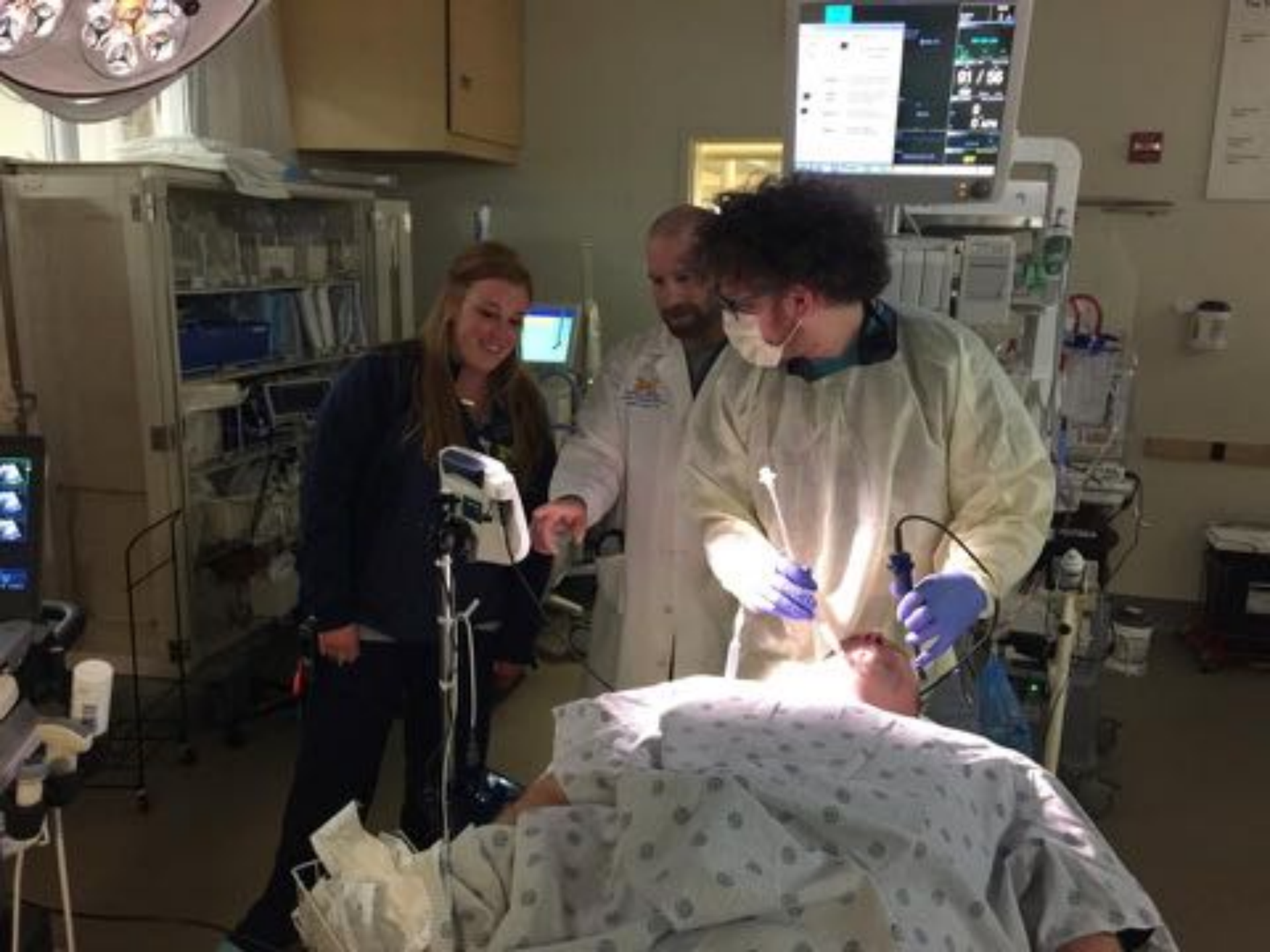
Storage Space/Technology

Full Scale Mock-up

Value Stream Mapping







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