

THE INTERNATIONAL ACADEMY FOR DESIGN & HEALTH  
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# CRITICAL CARE UNIT DESIGN

*The Winners and Future Trends:  
An Investigative Study*

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2008-2009 Tradewell Fellow  
WHR Architects - Houston, Texas, USA

# CRITICAL CARE UNIT DESIGN

## *SCCM: 17 Years of Winning ICU Designs*



### ***1992 ICU Design Competition Winner***

The Swedish Medical Center  
Englewood, Colorado, USA



### ***2009 ICU Design Competition Winner***

Memorial Sloan-Kettering Cancer Center  
New York City, New York, USA

## ***The Society of Critical Care Medicine (SCCM)***

The largest **multiprofessional** organization dedicated to ensuring excellence and consistency in the practice of critical care.

With **14,000 members in 80 countries**, SCCM represents all professional components of the critical care team.

***Now in its 17<sup>th</sup> year, the design competition is sponsored by:***

- Society for Critical Care Medicine (SCCM)
- American Institute of Architects / Academy of Architecture for Health (AIA/AAH)
- American Association of Critical-Care Nurses (AACN)

# CRITICAL CARE UNIT DESIGN

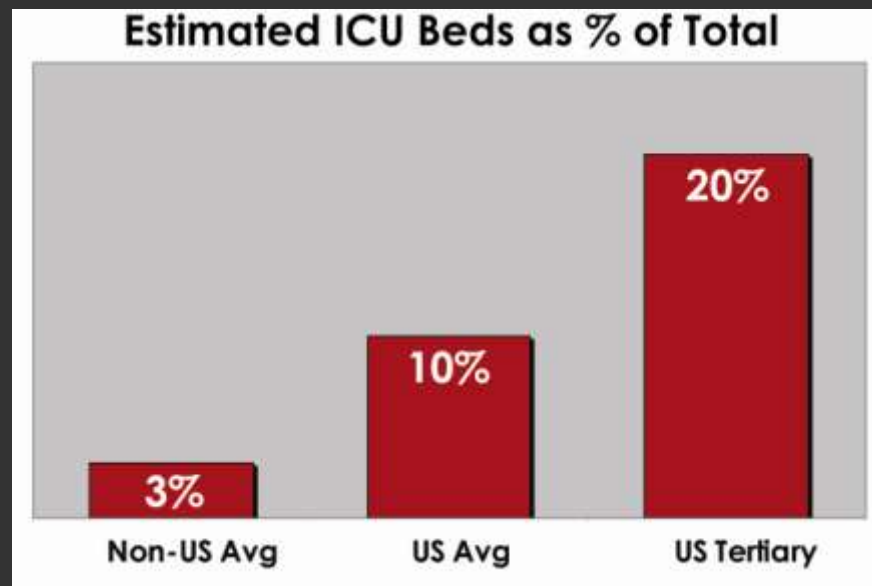
## Why is this Study Important?

### ICU Space Demand

In the United States, approximately **40 – 50%** of all hospital space is allocated to bed/inpatient units.

Of all US hospital beds, **10% to 20%** are ICU beds.

In the US, an ICU bed occupies **30% to 40%** more space than an acute bed.



Advisory Board, 2006

<sup>1</sup> Uhlenhake, R. (2006). *Study of Critical Care Unit Projects*. WHR Architects, Inc.

## Why is this Study Important?

### ICU Associated Costs

- ICU beds make up **< 20%** of all beds but consume **33%** of operating budgets.<sup>1</sup>
- ICU: **52%** more costly to build.<sup>2</sup>
- Cost/patient day **2-4 times** non-ICU patient day.<sup>2</sup>

**“No other space has more impact on efficiency of care.”**

Paula Buick, RN; Joseph O’Leary; Michael Roughan, AIA

<sup>1</sup> Buick, P, et al. *Critical Care Tertiary Facility Design presentation*. Design Symposium 2006.

<sup>2</sup> Advisory Board, 2006.

## Why is this Study Important?

### ICU Future Projections

- By 2020, there will be a **22%** deficit of intensivists to demand; by 2030, this deficit will increase to **35%**.<sup>1</sup>
- ICU patient days are projected to grow from **4% - 30%** more rapidly than non-ICU days.<sup>2</sup>

<sup>1</sup> Katz, J., et al. (2006). *Cardiology and the Critical Care Crisis*. Journal of the American College of Cardiology.

<sup>2</sup> Advisory Board, 2006.

## *ICU Design Competition*

### **FACT SHEET**

**Type of Institution**

**Type of Unit**

**Number of Beds**

**Size of Typical Patient Room**

**Type of Power/Equipment  
(headwall/power column)**

**Renovation/New Construction**

**SCCM ICU Design Manual Use**

**Design Summary**

## ICU Design Competition

### FACT SHEET

Type of Institution

Type of Unit

Number of Beds

Size of Typical Pa

Type of Power/Equ  
(headwall/power)

Renovation/New

SCCM ICU Design

Design Summary

### SCORING SHEET 1

#### Environmental Qualities:

Visual (color, light)

Simplicity (neatness)

Organization (layout)

Auditory (noise,  
avoidance, therapeutic  
sound)

Psychologic Amenities  
(TV, VCR, plants)

# CRITICAL CARE UNIT DESIGN

## ICU Design Competition

### FACT SHEET

Type of Institution  
Type of Unit  
Number of Beds  
Size of Typical Patient  
Type of Power/Equipment  
(headwall/power)  
Renovation/New  
SCCM ICU Design  
Design Summary

### SCORING SHEET

Environmental Quality  
Visual (color, light)  
Simplicity (neatness)  
Organization (layout)  
Auditory (noise, avoidance, therapeutic sound)  
Psychologic Amenities  
(TV, VCR, plants)

### SCORING SHEET 2

#### Features:

Size

Functionality

Safety/Security

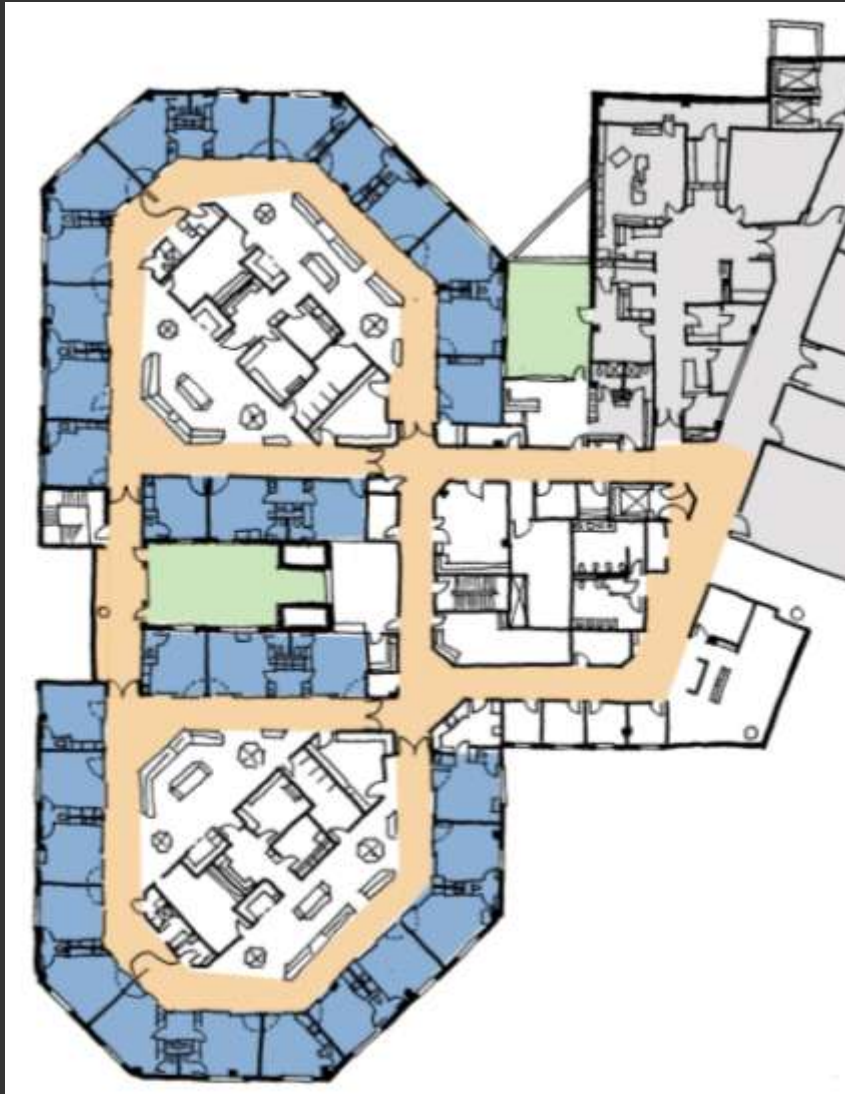
Decor

Amenities (refreshments, toiletry, sleep, seating)

Technology

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



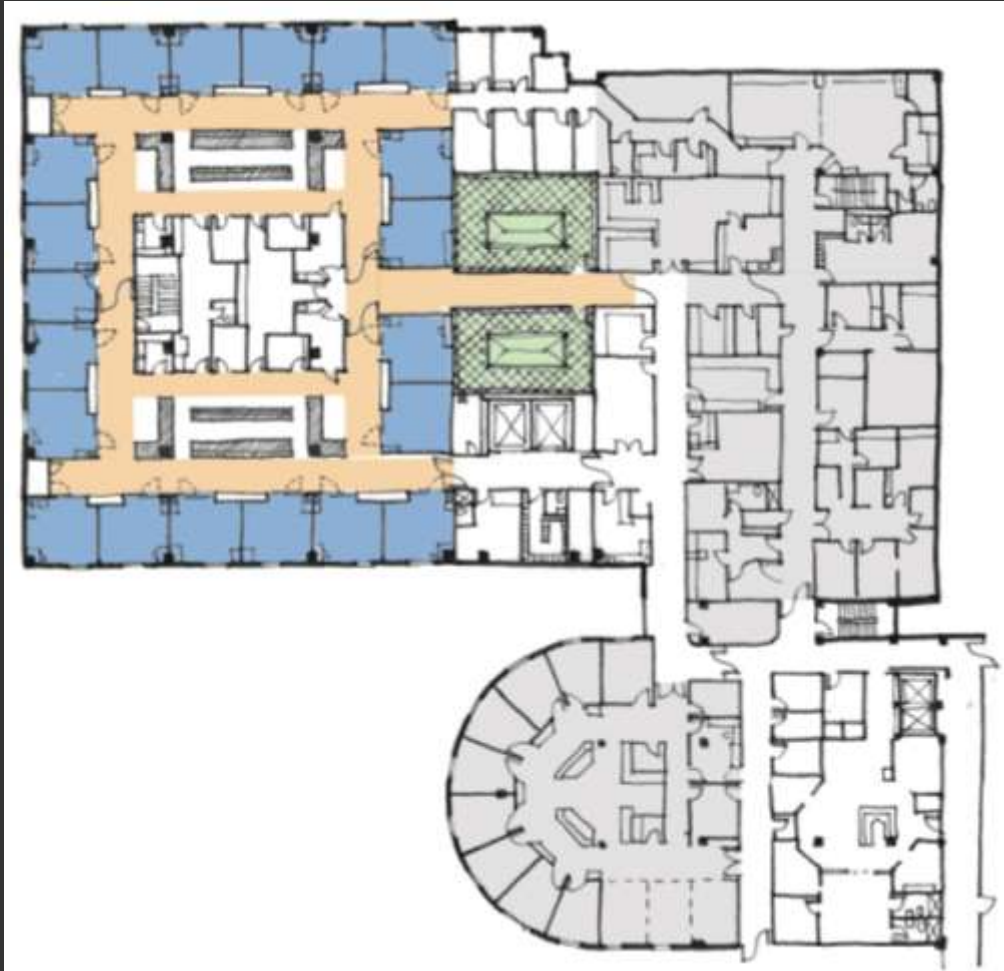
**1992**

**The Swedish Medical Center  
Englewood, Colorado, USA**

**32 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**1993**

**East Jefferson General Hospital**

**Metairie, Louisiana, USA**

**20 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**1996**

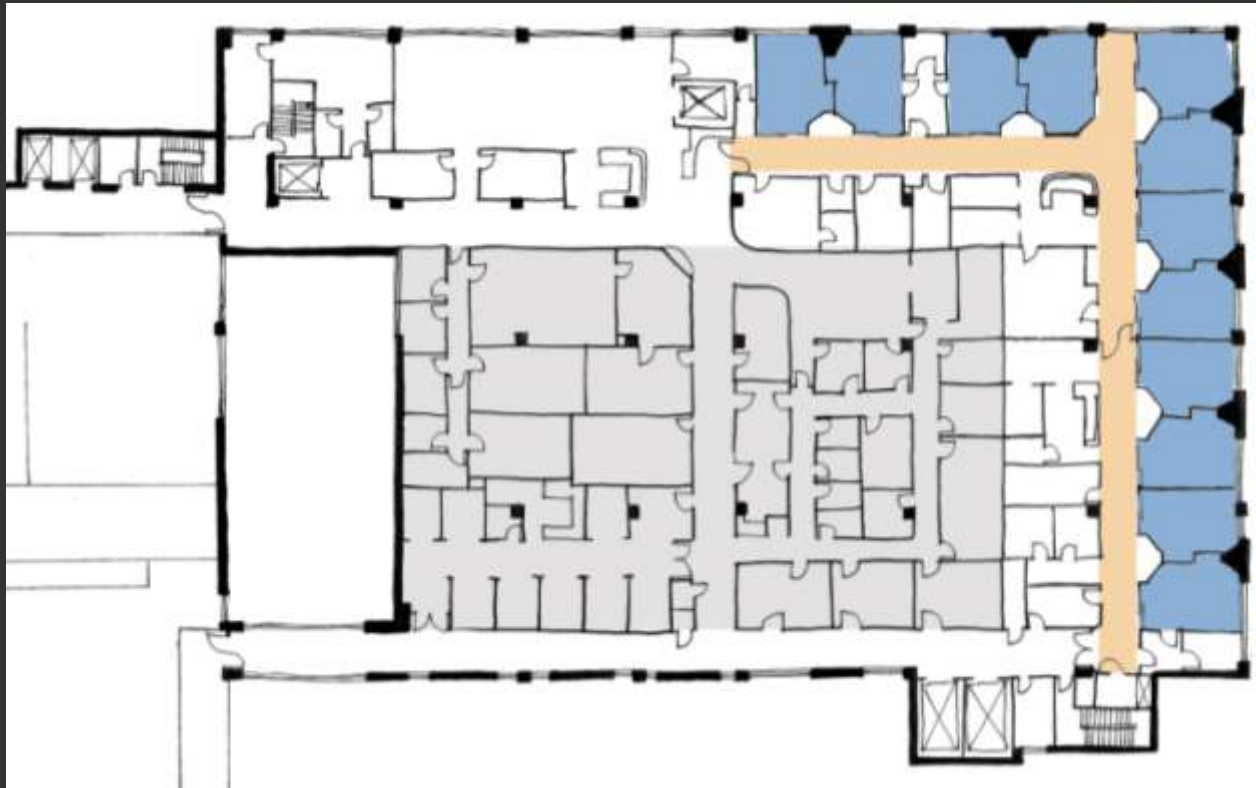
**Legacy Good  
Samaritan Hospital**

**Portland, Oregon, USA**

**28 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**1997**

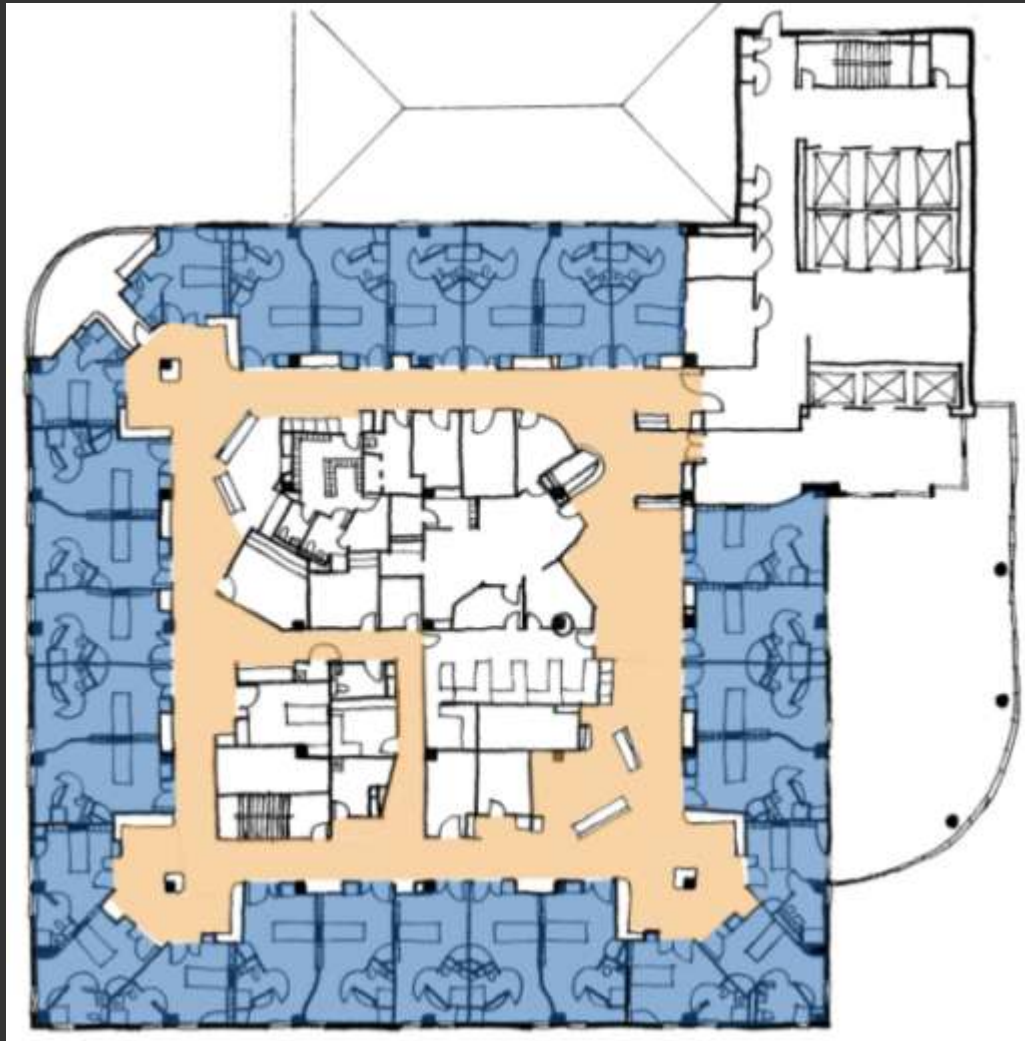
**Southeast Missouri  
Hospital**

**Cape Girardeau,  
Missouri, USA**

**12 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**2000**

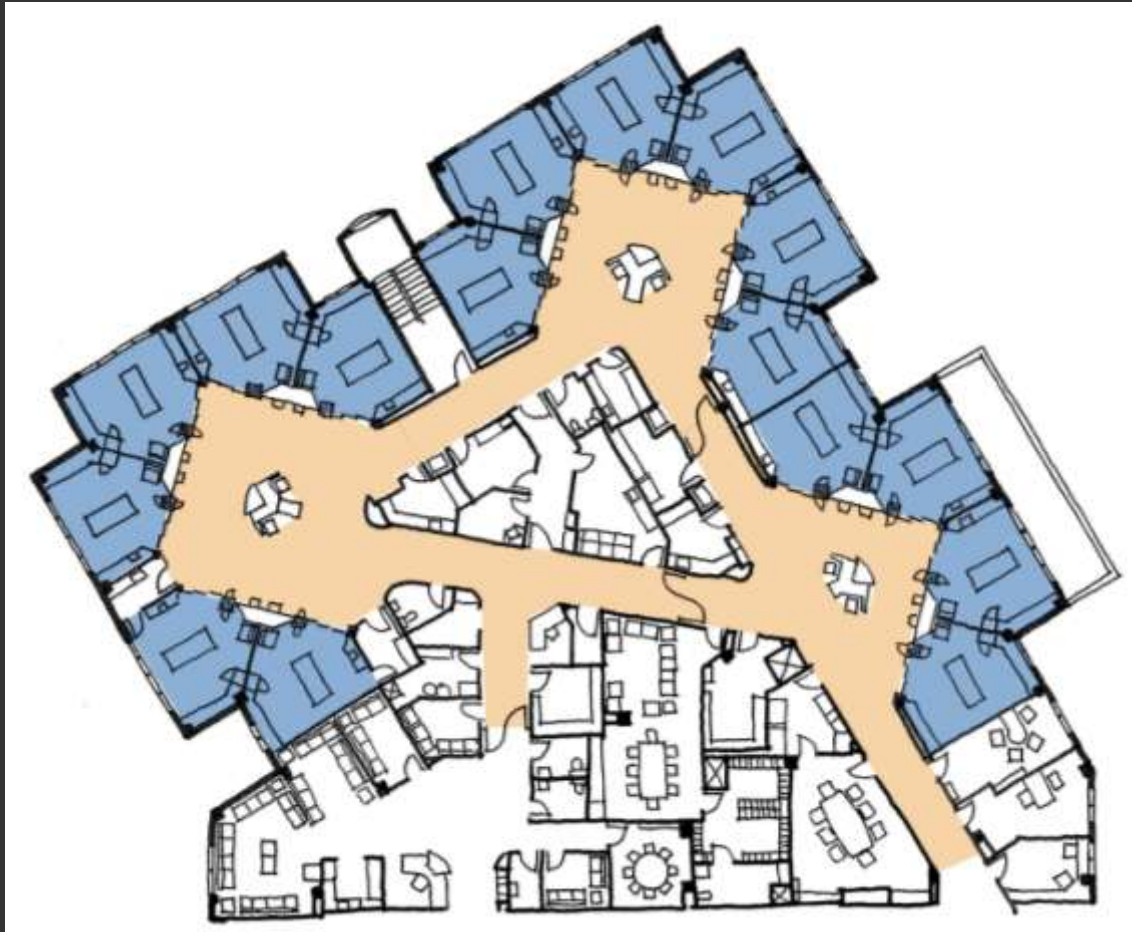
**Clarian Health Group  
Methodist Hospital**

**Indianapolis, Indiana, USA**

**56 Beds Total; 28/Floor**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



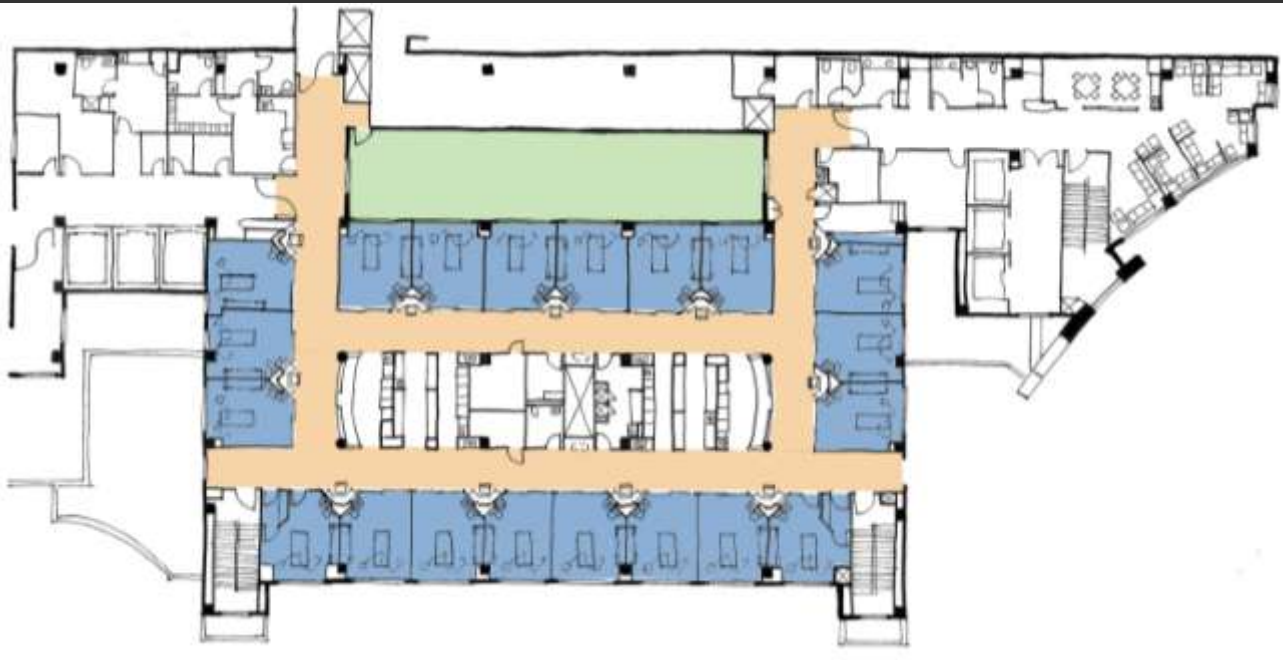
**2001**

**St. Joseph's Health Center  
Kansas City, Missouri, USA**

**16 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**2003**

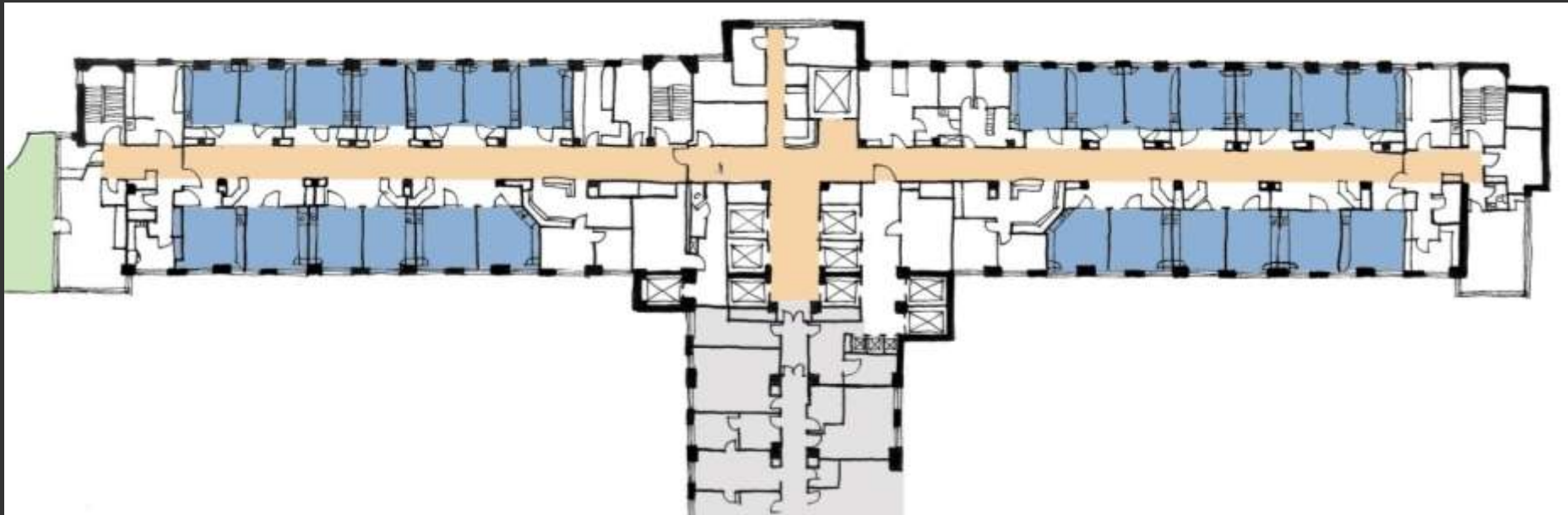
**Harris Methodist Fort  
Worth Hospital**

**Fort Worth, Texas, USA**

**20 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**2003**

**McGill University Health Center  
Montreal, Quebec, Canada**

**26 Beds**

# CRITICAL CARE UNIT DESIGN

## *Sample Size: 12 Winning ICU Designs*



**2005**

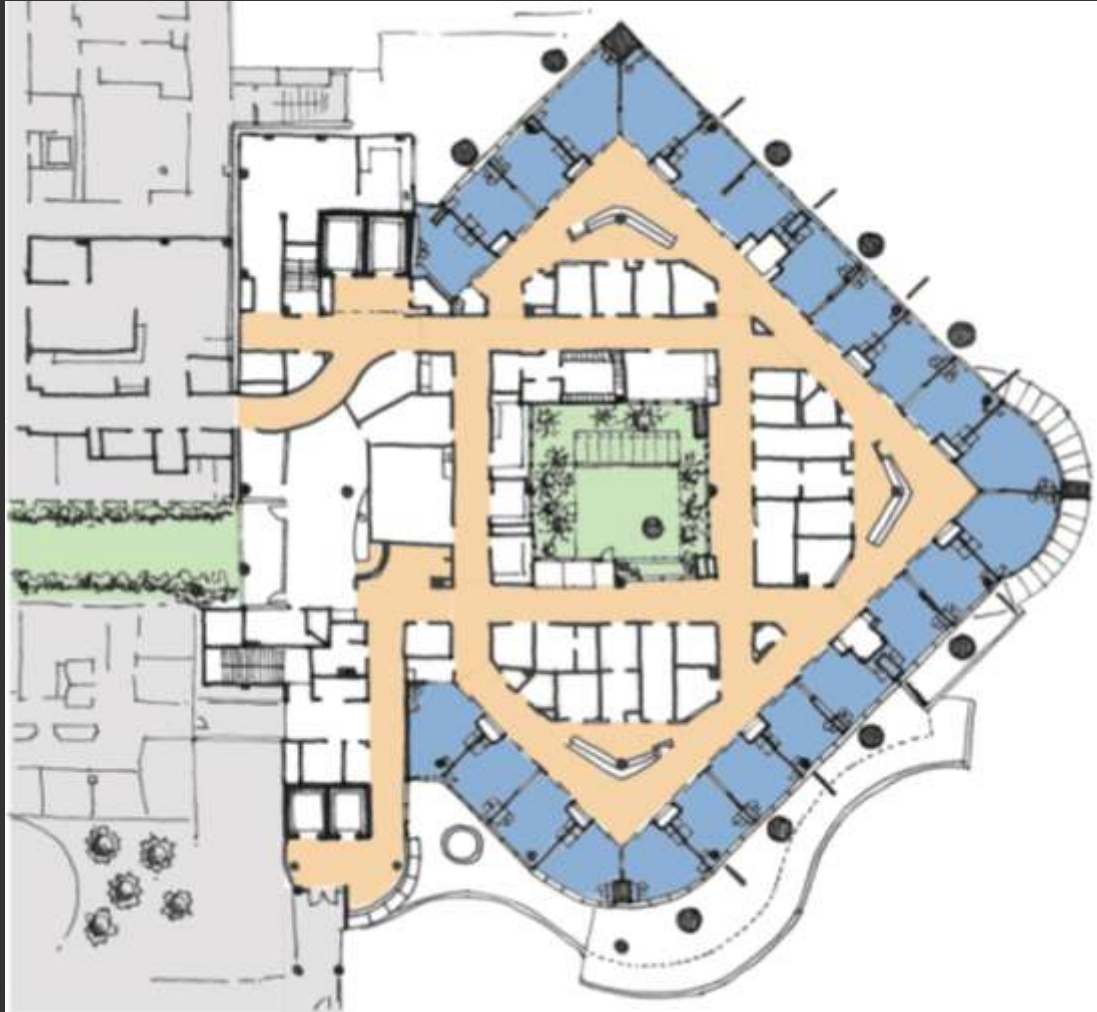
**The Queen's Medical  
Center**

**Honolulu, Hawaii, USA**

**40 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**2006**

**Sharp Grossmont Hospital**

**La Mesa, California, USA**

**24 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**2008**

**Emory University  
Hospital**

**Atlanta, Georgia, USA**

**20 Beds**

# CRITICAL CARE UNIT DESIGN

*Sample Size: 12 Winning ICU Designs*



**2009**

**Memorial Sloan-  
Kettering Cancer Center**

**New York City, New  
York, USA**

**20 Beds**

## *Data Analysis: Case Study*

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**Client:** **Emory University Hospital**

Emory Healthcare

Atlanta, Georgia, USA

Medical Director: **Owen Samuels, MD, FACM**

Evidence-Based Design Consultant:

**Craig Zimring, PhD, Georgia Tech University**

**Architect:** **HKS Architects**

Atlanta, Georgia, USA

# CRITICAL CARE UNIT DESIGN

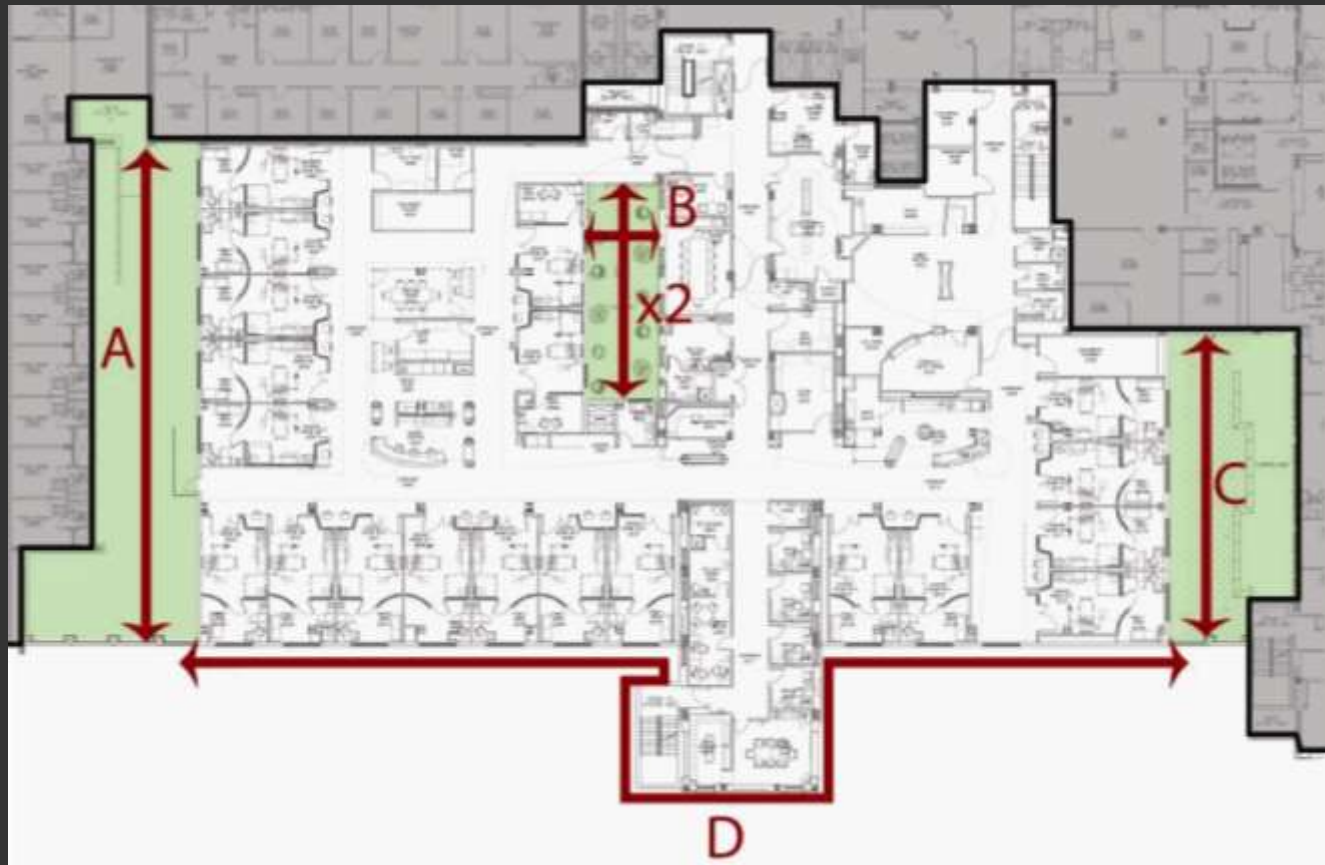
*Emory ICU, Atlanta, Georgia, USA*

**20 Beds**



# CRITICAL CARE UNIT DESIGN

## Exterior Perimeter Dimensions



$$A + B + C + D$$
$$34.4\text{m (113ft)} + 11.6\text{m (125ft)} + 21.6\text{m (71ft)} + 96.6\text{m (317ft)} = 164.2\text{m (625ft)}$$

# CRITICAL CARE UNIT DESIGN

## Roof Gardens



A = 257.3 SM (2770 SF)  
B = 69.4SM (748 SF)  
C = 116.7 SM (1795 SF)

width x height

6.8m x 33.5m  
4.8m x 14.3m  
8.3m x 20.7m

# CRITICAL CARE UNIT DESIGN

## Area Summary (20 Beds)



Floor Departmental Gross	=	2,384 SM (25,658 SF)	=	<b>115.4 SM/Bed (1,242 SF/Bed)</b>
Departmental Gross	=	2,053 SM (22,097 SF)	=	<b>102.6 SM/Bed (1,104 SF/Bed)</b>
Departmental Net	=	1,325 SM (14,269 SF)	=	<b>66.2 SM/Bed (713 SF/Bed)</b>

# CRITICAL CARE UNIT DESIGN

## Room Groupings

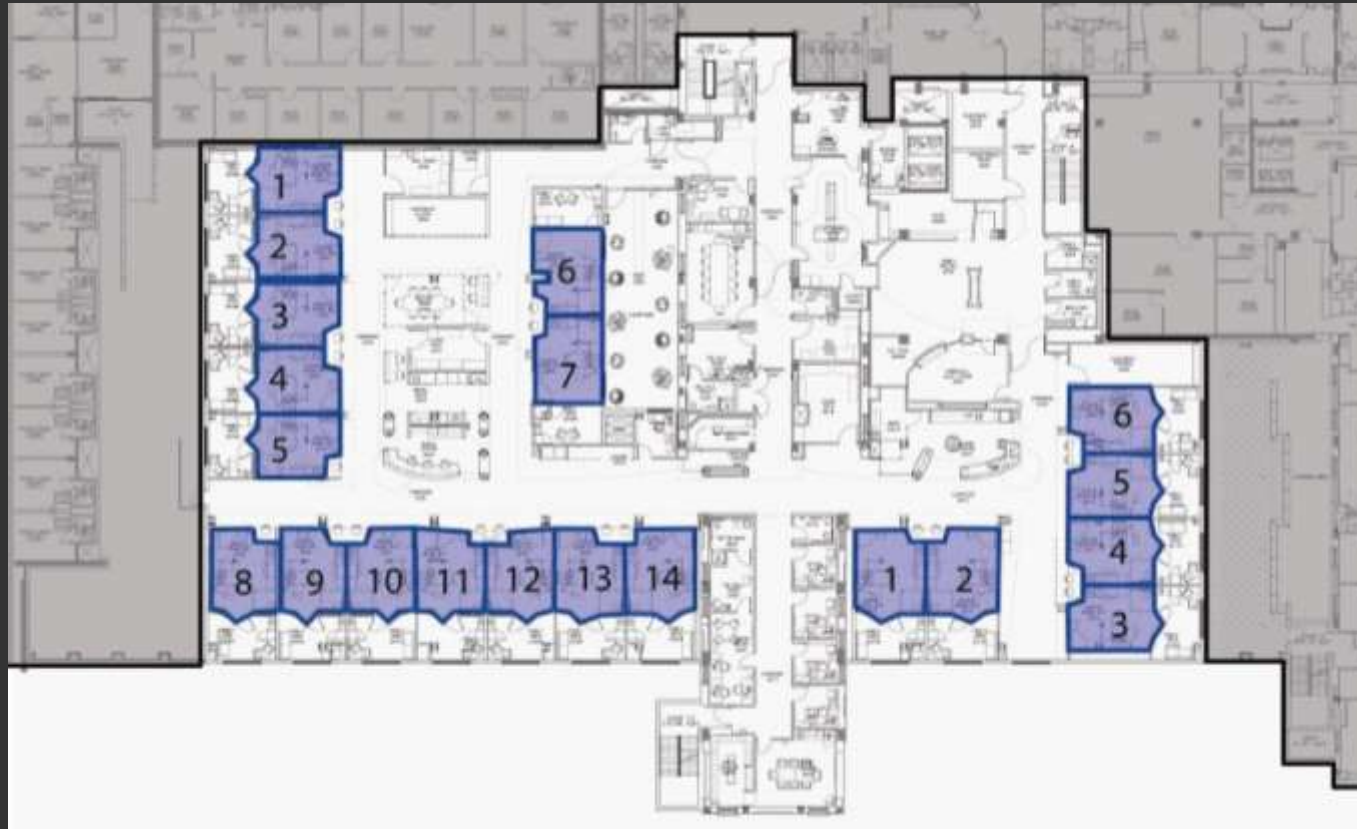


<b>Patient Room Groupings:</b>	<b>A</b>	= 14 Patient Rooms	671 SM (7,222 SF)	<b>33% of DGSM</b>
	<b>B</b>	= 6 Patient Rooms	418 SM (4,499 SF)	<b>20% of DGSM</b>
<b>Common Support:</b>	<b>C</b>	= Admin, Family, Diag.	964 SM (10,376 SF)	<b>47% of DGSM</b>

**TOTAL = 20.53 DGSM (22,097 DGSF)**

# CRITICAL CARE UNIT DESIGN

## *Patient Rooms*



**DGSM%**

**□ Patient Room- Patient 452 SM (4,868 SF) 22%**

# CRITICAL CARE UNIT DESIGN

## *Patient Rooms- Family Zone*



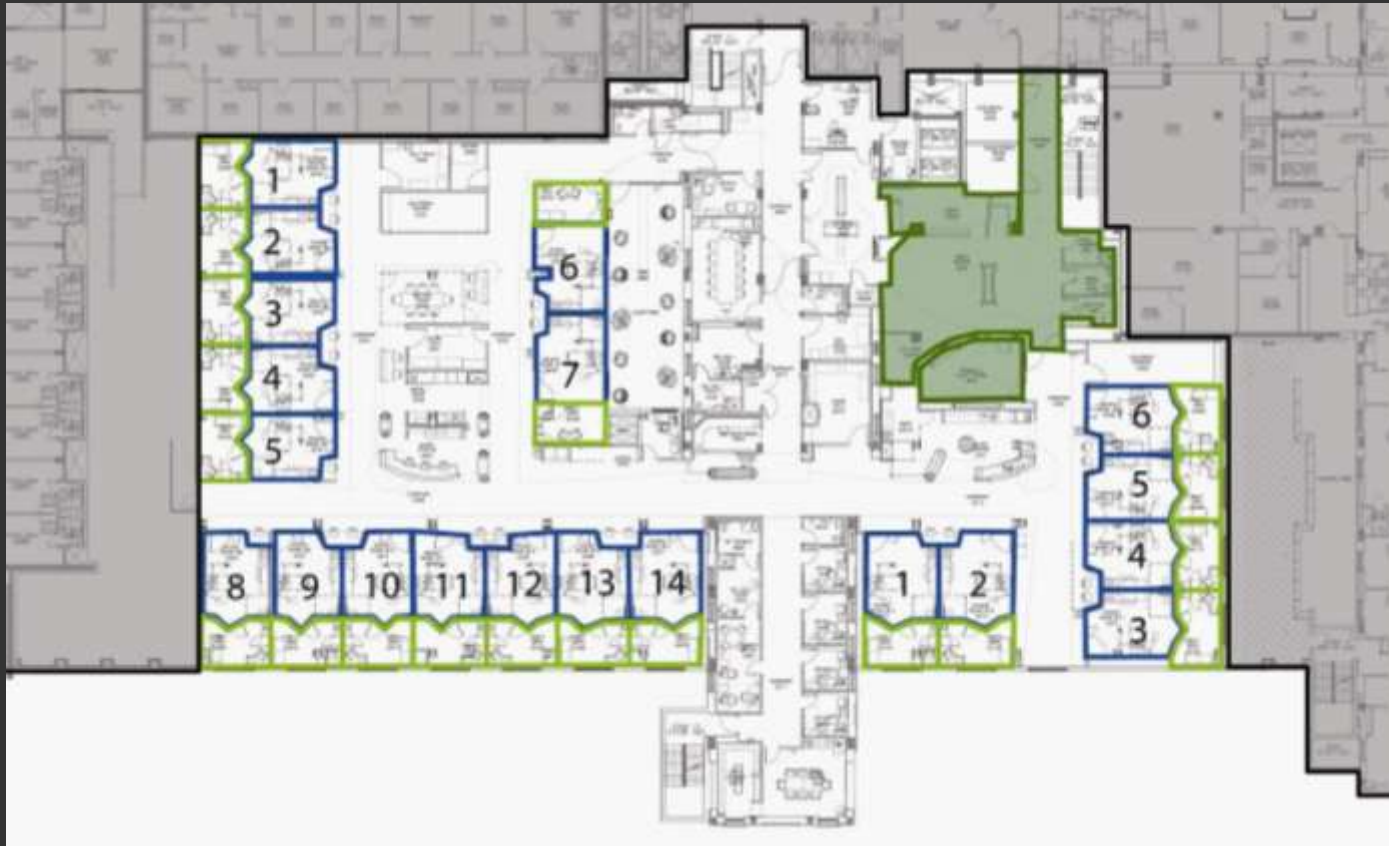
**DGSM%**

**■ Patient Room- Patient 452 SM (4,868 SF) 22%**

**■ Patient Room- Family 237 SM (2,550 SF) 12%**

# CRITICAL CARE UNIT DESIGN

## *Public, Family, & Visitor Spaces*



### DGSM%

- Patient Room- Patient 452 SM (4,868 SF) **22%**
- Patient Room- Family 237 SM (2,550 SF) **12%**
- Public/Family/Visitor 126 SM (1,354 SF) **6%**

# CRITICAL CARE UNIT DESIGN

## Patient Care Support



	DGSM%
■ Patient Room- Patient 452 SM (4,868 SF)	22%
■ Patient Room- Family 237 SM (2,550 SF)	12%
■ Public/Family/Visitor 126 SM (1,354 SF)	6%

■ Patient Care Support 286 SM (3,081 SF)	14%
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# CRITICAL CARE UNIT DESIGN

## Administrative Support



DGSM%

■ Patient Room- Patient	452 SM (4,868 SF)	<b>22%</b>
■ Patient Room- Family	237 SM (2,550 SF)	<b>12%</b>
■ Public/Family/Visitor	126 SM (1,354 SF)	<b>6%</b>

DGSM%

■ Patient Care Support	286 SM (3,081 SF)	<b>14%</b>
■ Admin. Support	187 SM (2,017 SF)	<b>9%</b>

# CRITICAL CARE UNIT DESIGN

## Diagnostic Imaging Spaces

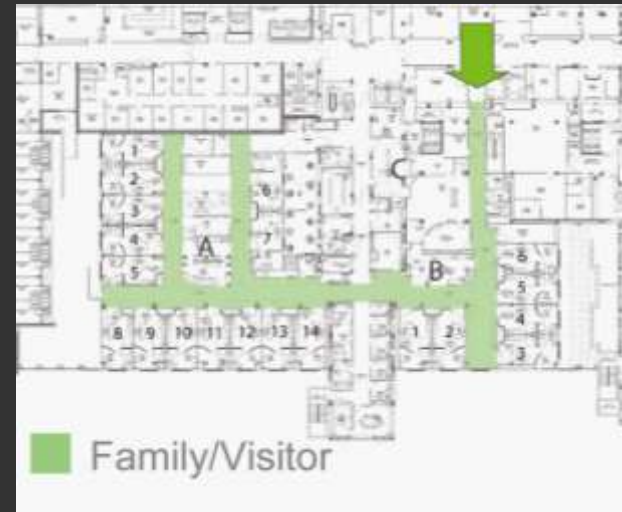


		DGSM%
■ Patient Room- Patient	452 SM (4,868 SF)	<b>22%</b>
■ Patient Room- Family	237 SM (2,550 SF)	<b>12%</b>
■ Public/Family/Visitor	126 SM (1,354 SF)	<b>6%</b>

		DGSM%
■ Patient Care Support	286 SM (3,081 SF)	<b>14%</b>
■ Admin. Support	187 SM (2,017 SF)	<b>9%</b>
■ Diagnostic/Imaging	73 SM (783 SF)	<b>4%</b>

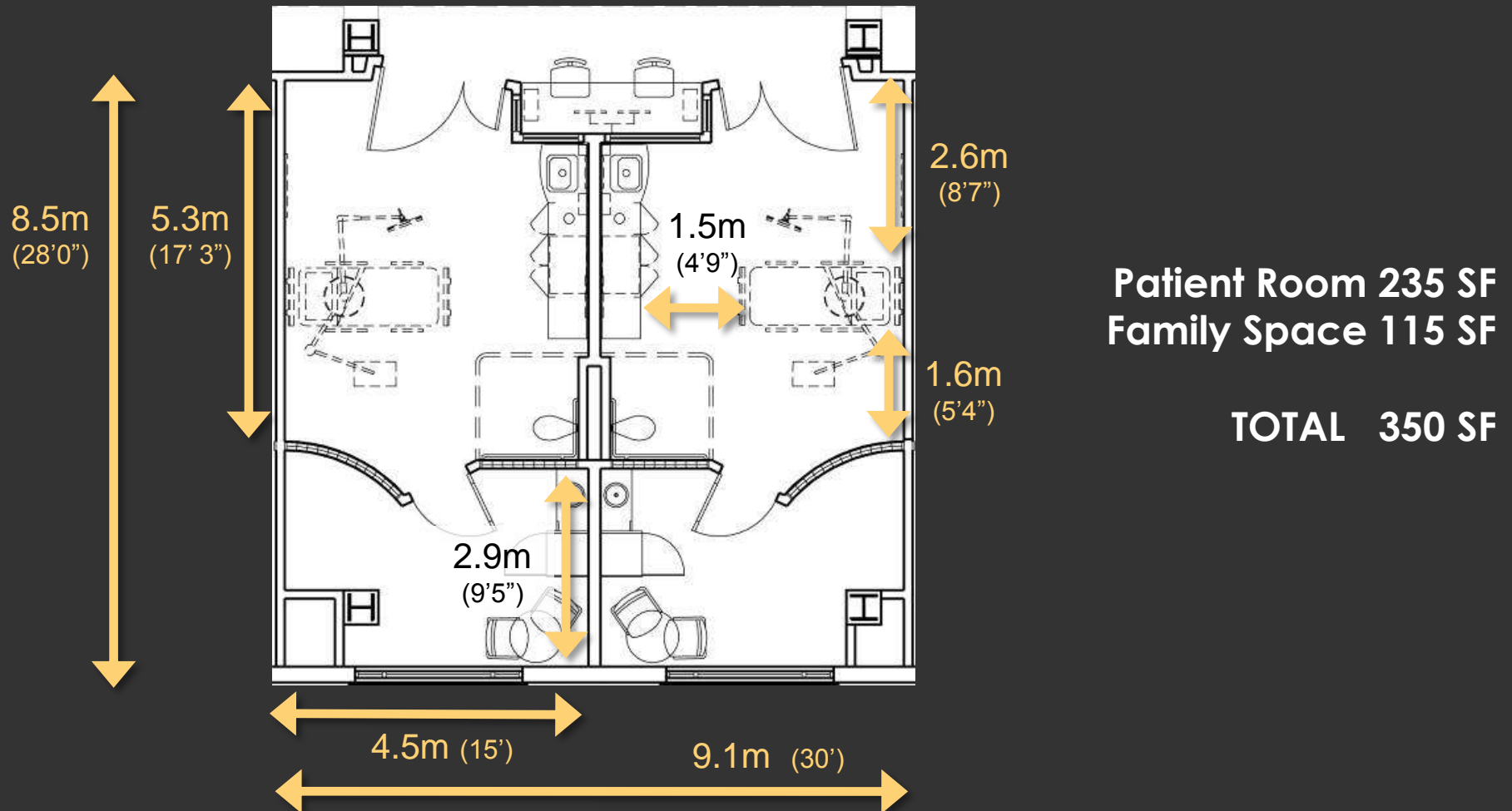
# CRITICAL CARE UNIT DESIGN

## Circulation Paths



# CRITICAL CARE UNIT DESIGN

## Patient Rooms



**Patient Room 235 SF**  
**Family Space 115 SF**

**TOTAL 350 SF**

# CRITICAL CARE UNIT DESIGN

## Winning ICU Designs 1992-2009



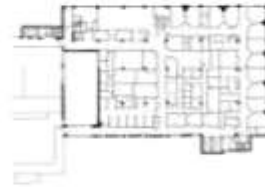
1992



1993



1996



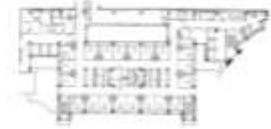
1997



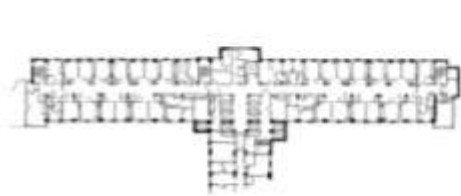
2000



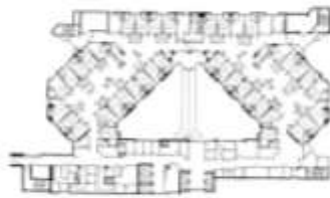
2001



2003



2003



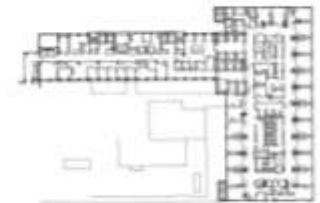
2005



2006



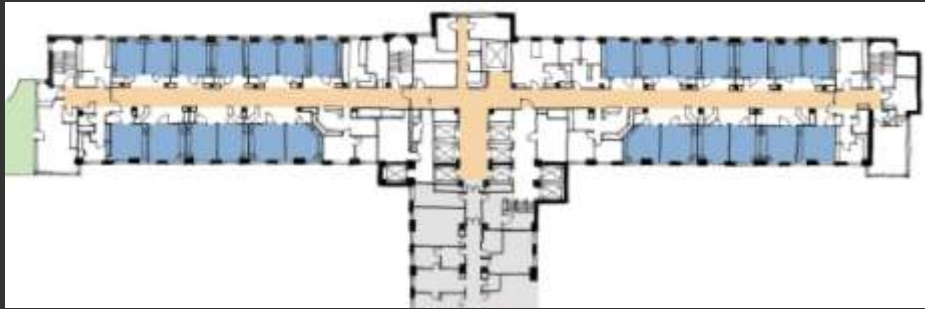
2008



2009

# CRITICAL CARE UNIT DESIGN

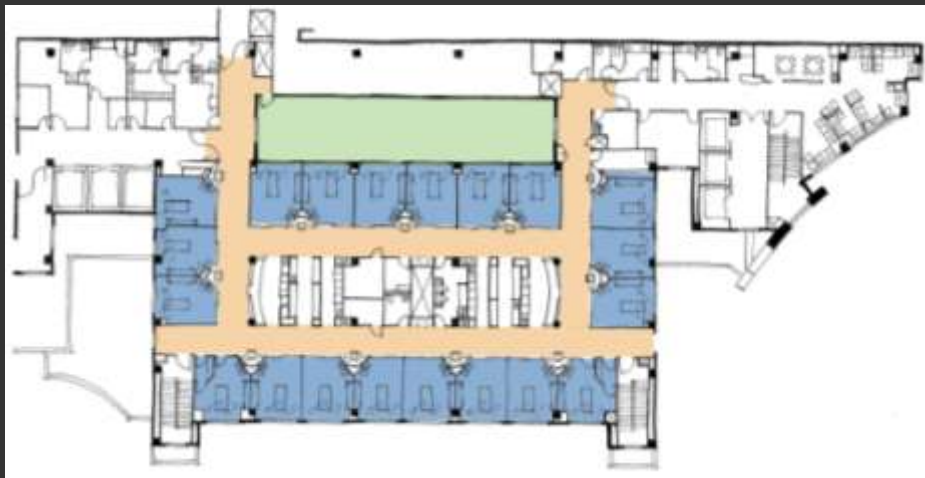
## Unit Configurations



**Linear**



**Pod**



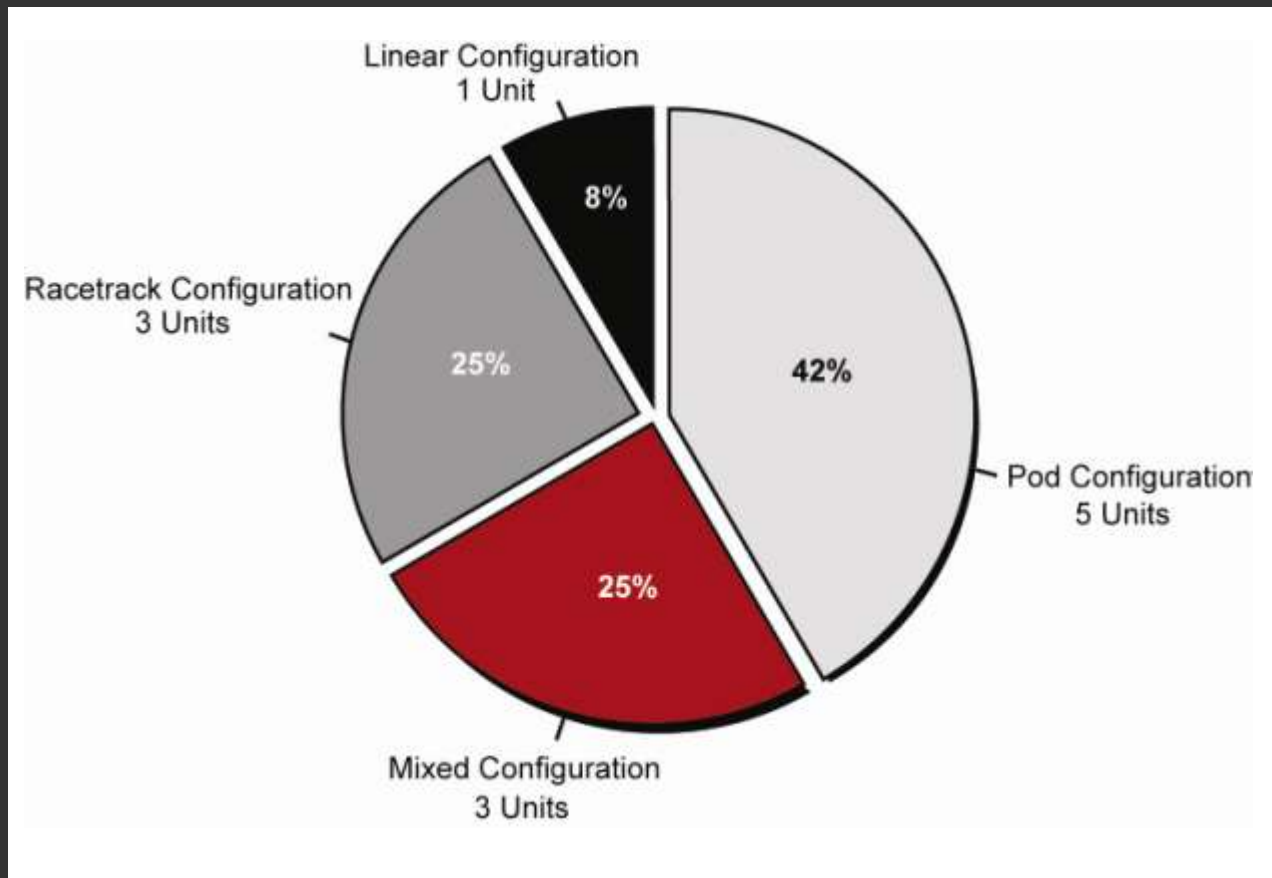
**Racetrack**



**Mixed**

# CRITICAL CARE UNIT DESIGN

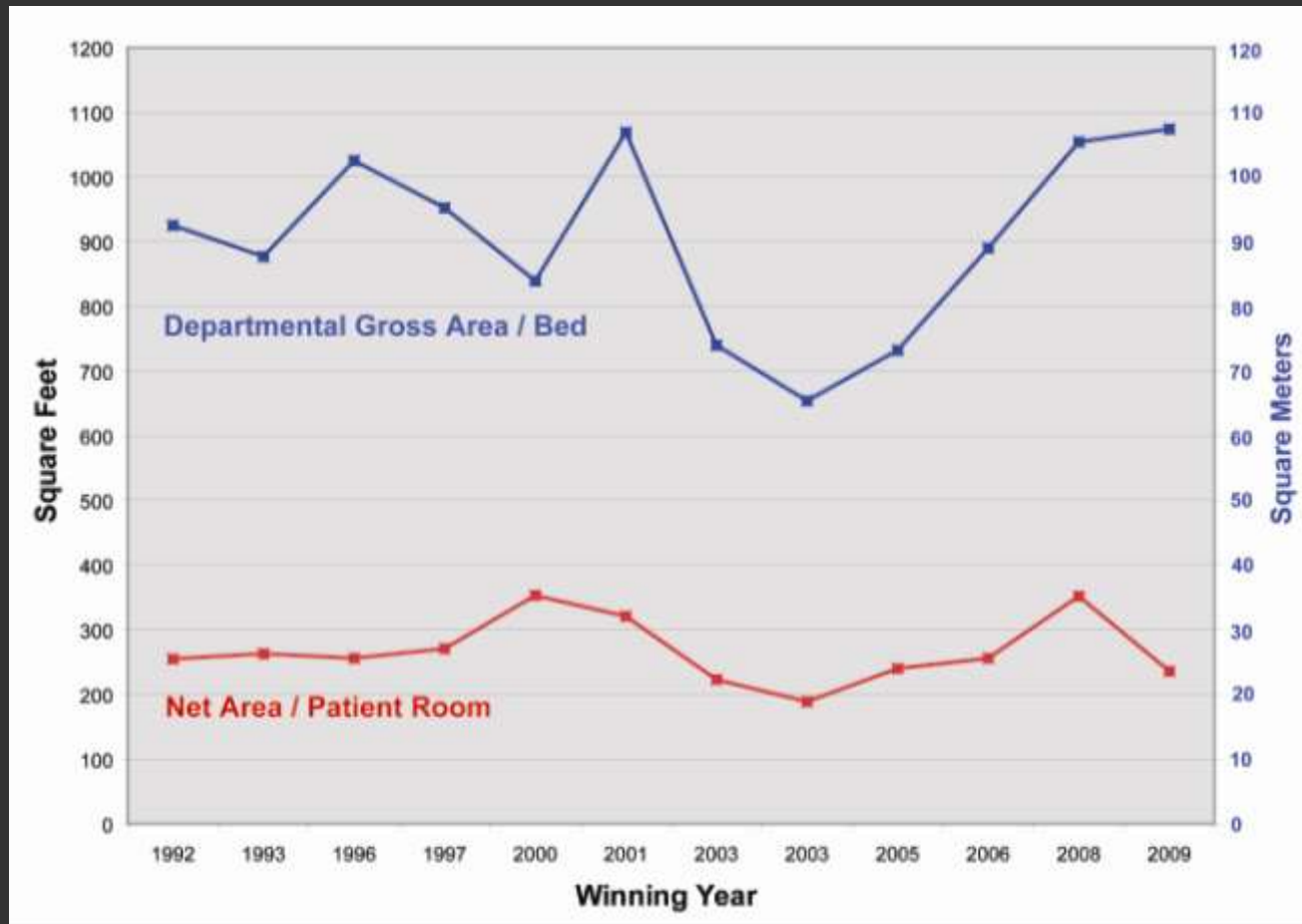
## Unit Configurations



**Categorization of ICUs on the basis of unit configuration**

# CRITICAL CARE UNIT DESIGN

## Area Take-Off Analysis of Winning Units



**Comparison of departmental gross areas per patient bed and patient room net areas**

# CRITICAL CARE UNIT DESIGN

## Area Take-Off Analysis of Winning Units

### Unit Departmental Area per Bed and Average Grossing Factors

Construction Type	Average Dept Area/Bed		Avg Factors
	DGSF/Bed	DGSM/Bed	
New Construction	1,040	97	1.57
New & Renovation Construction (Mixed)	820	76	1.65
Renovation Construction	900	84	1.69

Average unit departmental area per patient bed & average net to departmental area grossing factors by construction type

7 New Construction  
2 Mixed (New & Reno.)  
3 Renovation

# CRITICAL CARE UNIT DESIGN

## Area Take-Off Analysis of Winning Units

	Percentage Range	Variance	Average
<b>1 Patient Care</b> Includes the patient room and patient toilet room	38.6 - 68.1%	29.5%	48.0%
<b>2 Staff &amp; Material Support</b> Includes centralized & decent charting, clean & soiled, etc.	15.1 - 32.0%	16.9%	23.0%
<b>3 Staff Facilities</b> Includes staff lounge, lockers, toilets, on-call rooms, etc.	3.0 - 9.1%	6.1%	6.0%
<b>4 Diagnostic &amp; Therapeutic</b> Includes imaging suites, dialysis, pharmacy, lab, etc.	0.0% - 8.1%	8.1%	2.0%
<b>5 Administration &amp; Education</b> Includes classrooms, conference spaces, offices, etc.	2.8 - 24.2%	21.4%	9.0%
<b>6 Public &amp; Family</b> Includes waiting areas, family sleep rooms, amenities, etc.	5.7 - 25.2%	19.5%	12.0%

Program categories used during area take-off analysis of best-practice ICU designs & percentages of total department area

## *10 Best-Practice Critical Care Design Trends*

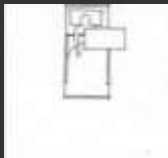
- 1. Larger, Consolidated Units**
- 2. Stabilized Patient Room Size**
- 3. Defined In-Room Family Space**
- 4. Remote Technology & Support Systems**
- 5. Continued Design for Interdisciplinary Teams**
- 6. Integration of Diag. & Treatment Facilities**
- 7. Integration of Admin. & Support Spaces**
- 8. Variable Unit Geometry**
- 9. Segregated Circulation**
- 10. Visual & Physical Access to Nature**

## 10 Best-Practice Critical Care Design Trends

### (1) Larger Units

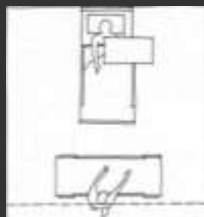
More units and larger units will likely be needed in the future as demand grows. Area for support spaces will likely increase.

1970



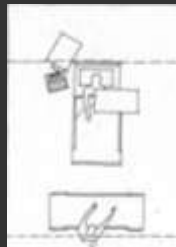
450 SF/  
bed

1980



550 SF/  
bed

1990



650 SF/  
bed

2000



Swedish

750 SF/  
bed

2010



Queen's

900 SF/  
bed

## 10 Best-Practice Critical Care Design Trends

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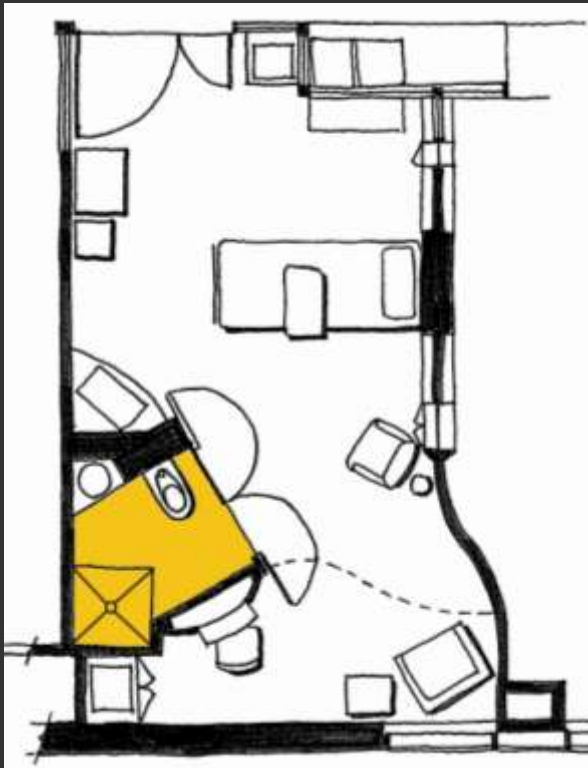
### ***(2) The Patient Room***

**All-private rooms in critical care will become the design standard with a stable room size of about 250 SF (23 SM); family space will likely be in addition to this.**

# CRITICAL CARE UNIT DESIGN

## *The Patient Room*

**Private toilet facility within acuity adaptable room and flat headwall**



Clarian Health Group Methodist Hospital, Indianapolis, Indiana  
2000 winner



Photo: BSA LifeStructures

## 10 Best-Practice Critical Care Design Trends

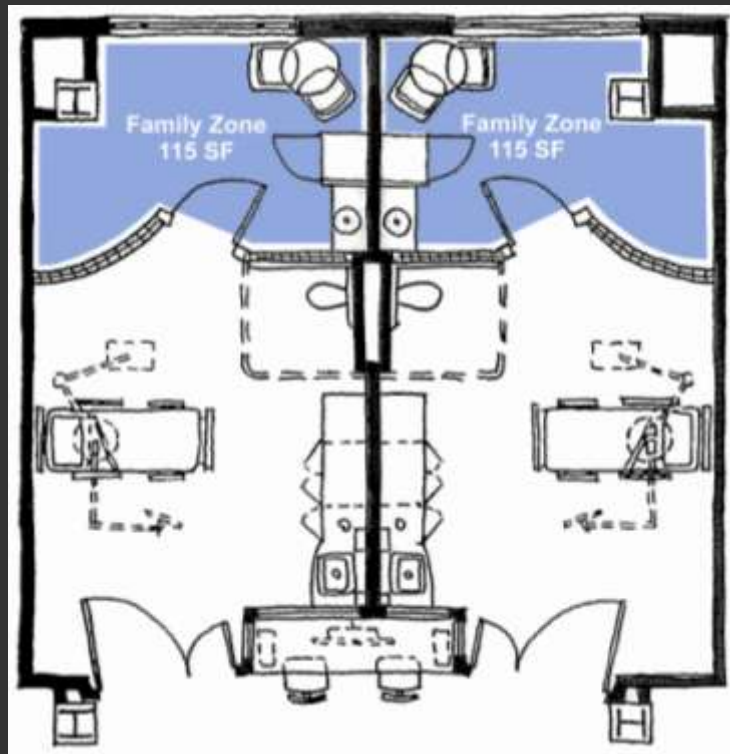
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### ***(3) The Family Zone***

**Recent units, where possible, incorporate designated family and visitor space and amenities into the unit or within the patient room itself.**

# CRITICAL CARE UNIT DESIGN

## *The Family Zone*



Emory University Hospital ICU  
Atlanta, Georgia  
2008 winner



Photos: Owen Samuels, M.D., ICU Medical Director

## 10 Best-Practice Critical Care Design Trends

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### ***(4) Technology & Life Support Systems***

**The majority of units, notably recent ones, employed ceiling mounted booms rather than the traditional headwall unit within the patient room design.**

# CRITICAL CARE UNIT DESIGN

## Technology & Life Support Systems

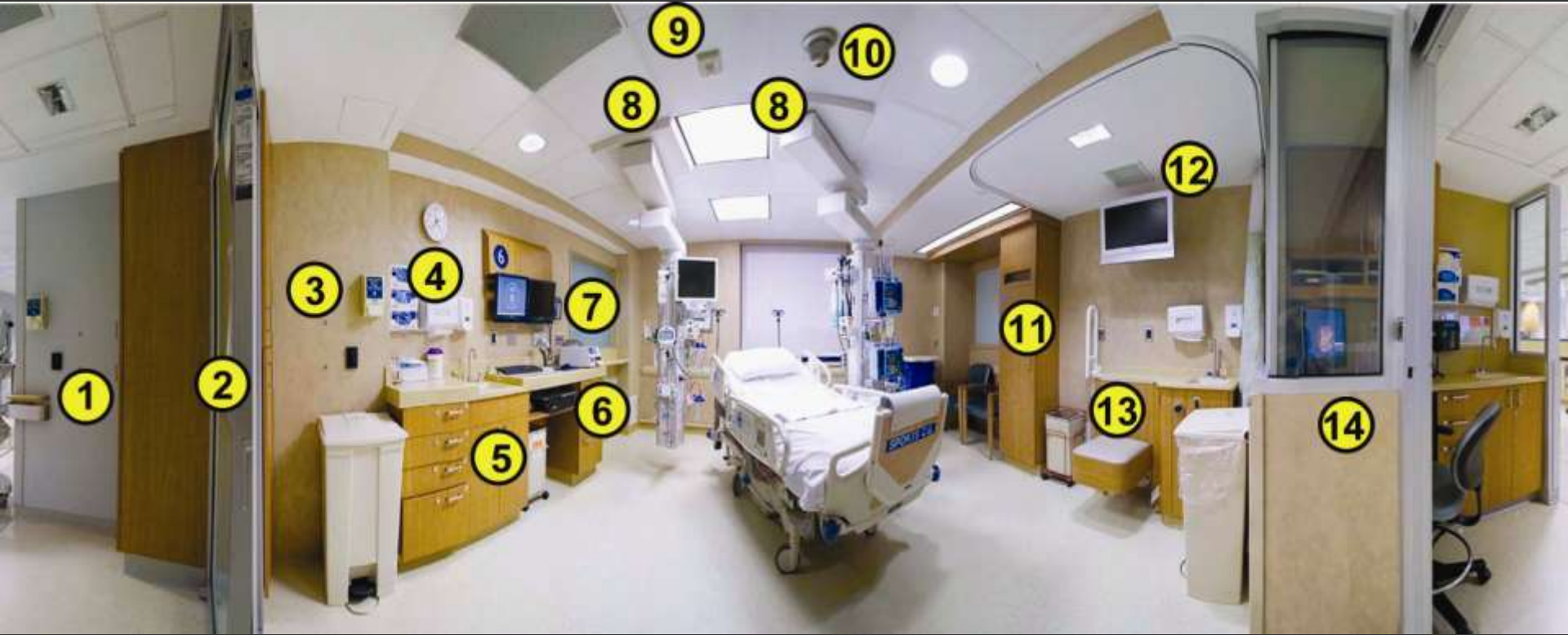


Photo: MSKCC & Neil Halpern, M.D., ICU Medical Director

- |                                   |                             |                                |
|-----------------------------------|-----------------------------|--------------------------------|
| 1 Nurse server                    | 6 Computer & double monitor | 11 Patient closet & DVD player |
| 2 E-glass slide, break away doors | 7 Lab label printer         | 12 Flat screen TV              |
| 3 Inside opening of nurse server  | 8 Twin BOOMS                | 13 Toilet                      |
| 4 Wireless clock                  | 9 Wireless IR transmitter   | 14 Nursing work area           |
| 5 Storage cabinets                | 10 Web cam                  |                                |

## 10 Best-Practice Critical Care Design Trends

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### ***(5) Design for Interdisciplinary Teams***

**All units showed some combination of centralized & decentralized layouts for staff work stations, while only two designs were fully decentralized.**

# CRITICAL CARE UNIT DESIGN

## *Design for Interdisciplinary Teams*



**St. Joseph's Health Center**  
Kansas City, Missouri  
2001 winner



**Emory University Hospital**  
Atlanta, Georgia, USA  
2008 winner

## 10 Best-Practice Critical Care Design Trends

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### ***(6) Proximity to Diagnostic & Treatment***

**Recent units appear to be incorporating diagnostic and treatment modalities into their designs, often as shared services with the entire hospital.**

# CRITICAL CARE UNIT DESIGN

## *Proximity to Diagnostic & Treatment*



**Proximity of ICU to cardiac catheterization suite**

Swedish Medical Center ICU, Englewood, Colorado, 1992 winner

## 10 Best-Practice Critical Care Design Trends

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### ***(7) Administrative & Support Space***

**An increase in administrative and education space within the unit has been noted over the last several years, particularly within teaching hospitals.**

# CRITICAL CARE UNIT DESIGN

## *Administrative & Support Spaces*



Emory University Hospital Neurosciences ICU  
Atlanta, Georgia, 2008 winner

# CRITICAL CARE UNIT DESIGN

## *Administrative & Support Spaces*

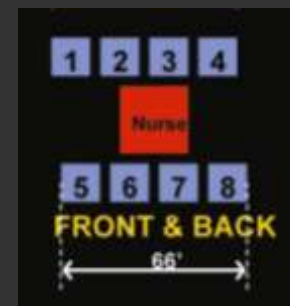
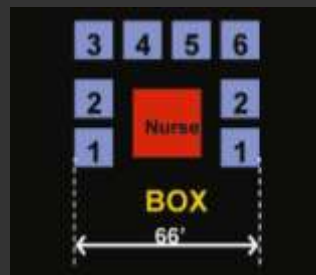
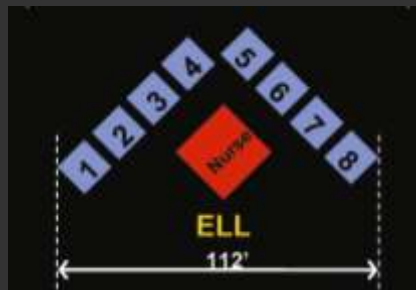
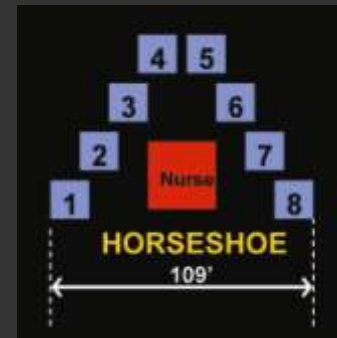
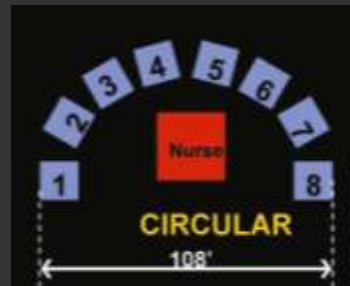


Memorial Sloan-Kettering Cancer Center ICU,  
New York City, New York, 2009 winner

## 10 Best-Practice Critical Care Design Trends

### (8) Unit Geometry

No single ICU geometry has been noted as superior to another; the pod concept is seen in recent years, along with a combination of different configurations.



## 10 Best-Practice Critical Care Design Trends

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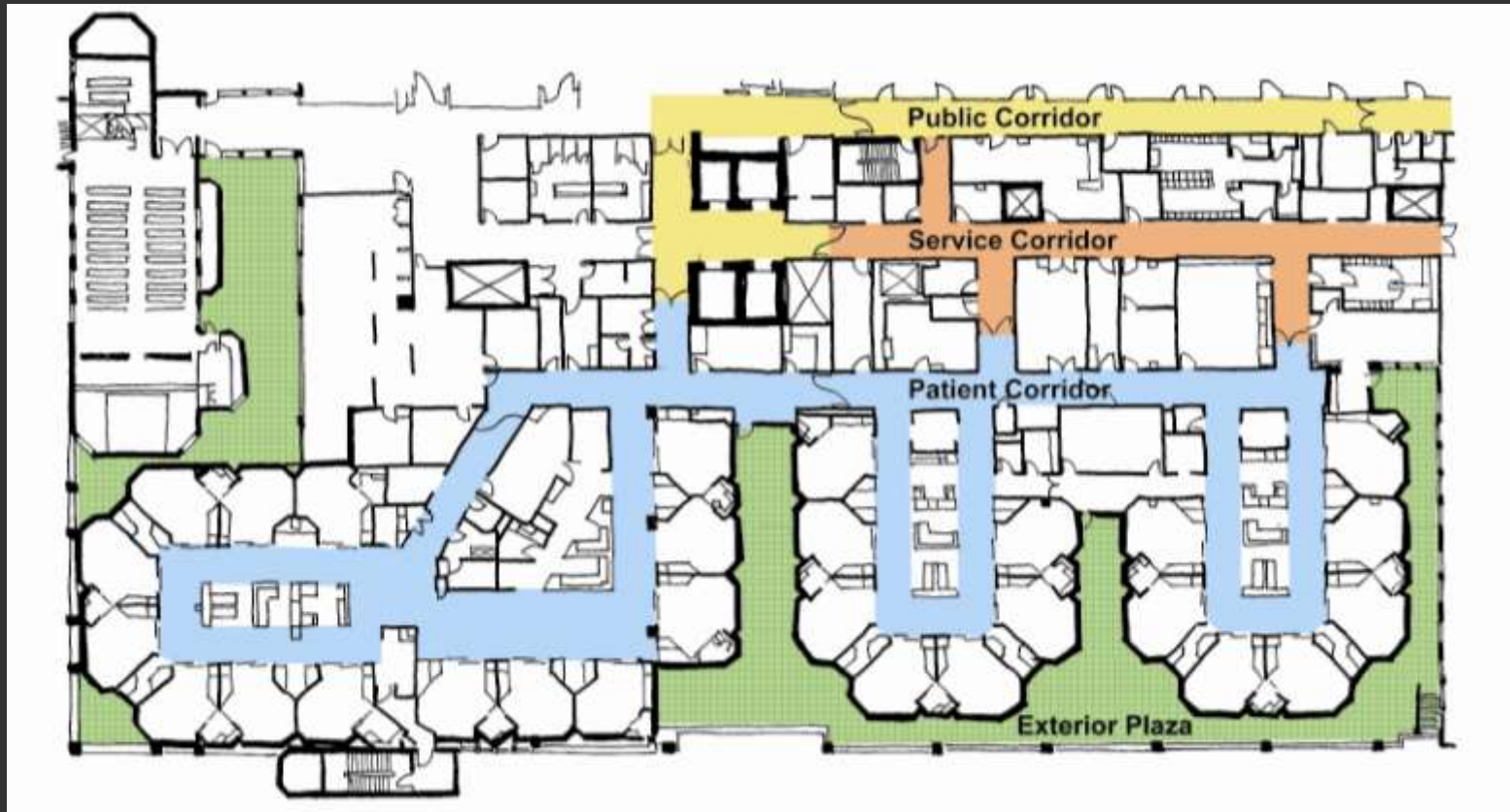
### ***(9) Unit Circulation***

**Distinction of circulation regarding on-stage and off-stage separations are becoming more common and will likely continue to be seen in future designs.**

# CRITICAL CARE UNIT DESIGN

## *Unit Geometry & Circulation*

**Unique geometry allowing increased unit perimeter and plaza access; on-stage/off-stage circulation**



Legacy Good Samaritan Multidisciplinary ICU, Portland, Oregon, 1996 winner

## 10 Best-Practice Critical Care Design Trends

### **(10) Access to Nature**

**The importance of nature for patients, families and staff is increasingly recognized and incorporated into critical care units where possible.**

**“Nature serves as a positive distraction that reduces stress and diverts patients from focusing on their pain or distress.”**

**– Ulrich, 2008**

# CRITICAL CARE UNIT DESIGN

## *Access to Nature*

**Legacy Good Samaritan**  
Multidisciplinary ICU  
Portland, Oregon, USA  
1996 winner



Photo: Kirk Hamilton, FAIA, FACHA

**THANK YOU!**

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# CRITICAL CARE UNIT DESIGN

*The Winners and Future Trends:  
An Investigative Study*

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