Intensive Care Unit Design
25 Years of Winning Trends

European Healthcare Design Congress
London, United Kingdom
June 27, 2016

Diana Anderson, MD, MArch
Dochitect, Stantec Architecture
“The hospital is a human intervention and as such, can be reinvented at any time.”

– Leland Kaiser, Hospital Futurist
ICU Design of Tomorrow
What Can We Expect?

MORE HOME. LESS HOSPITAL.
From National to Global Design Submissions
25 Years of Winning Designs
Guidelines for intensive care unit design

Dan R. Thompson, MD, MA, FACP, FCCM (Co-Chair); D. Kirk Hamilton, FAIA, FACHA (Co-Chair); Charles D. Cadenhead, FAIA, FACHA, FCCM; Sandra M. Swoboda, RN, MS, FCCM; Stephanie M. Schwindel, MArch, LEED, Diana C. Anderson, MD, MArch; Elizabeth V. Schmitz, AIA; Arthur C. St. Andre, MD, FCCM; Donald C. Axon, FAIA, FACHA; James W. Harrell, FAIA, FACHA, LEED AP; Maureen A. Harvey, RN, MPH, MCCM; April Howard, RN, CCRN, CCRC; David C. Kaufman, MD, FCCM; Cheryl Petersen, RN, MBA, CCRN

Objective: To develop a guideline to help guide healthcare professionals participate effectively in the design, construction, and occupancy of a new or renovated intensive care unit.

Participants: A group of multidisciplinary professionals, designers, and architects with expertise in critical care, under the direction of the American College of Critical Care Medicine, met over several years, reviewed the available literature, and collected their expert opinions on recommendations for the optimal design of an intensive care unit.

Scope: The design of a new or renovated intensive care unit is frequently a once- or twice-in-a-lifetime occurrence for most critical care professionals. Healthcare architects have experience in this process that most healthcare professionals do not. While there are regulatory documents, such as the Guidelines for the Design and Construction of Health Care Facilities, these represent minimal guidelines. The intent was to develop recommendations for a more optimal approach for a healing environment.

Data Sources and Synthesis: Relevant literature was accessed and reviewed, and expert opinion was sought from the committee members and outside experts. Evidence-based architecture is just in its beginning, which made the grading of literature difficult, and so it was not attempted. The previous designs of the winning American Institute of Architects, American Association of Critical Care Nurses, and Society of Critical Care Medicine Unit Design Award were used as a reference, meeting repeatedly, both in person and by conference call, to construct this recommendation.

Conclusions: Recommendations for new or reconfigured intensive care units, expanding on regulatory guidelines, may be necessary to provide a healing environment, and a new perspective is needed to achieve the highest standards of patient care.
ICU Citation Winners
25 Years of Winning Designs

1992 - THE SWEDISH MEDICAL CENTER, Englewood, Colorado
1993 - ST. ELIZABETH’S MEDICAL CENTER, Boston, Massachusetts
1995 - THE HOSPITAL FOR SICK CHILDREN, Toronto, Canada
1996 - SOUTHEAST MISSOURI HOSPITAL, Cape Girardeau, Missouri
1997 - THE CHILDREN’S MEDICAL CENTER, Dayton, Ohio
1998 - ADULT
1999 - PEDIATRIC
2000 - CLARIAN HEALTH GROUP METHODOIST HOSPITAL OF INDIANA, Indianapolis, Indiana
2001 - CHILDREN’S HOSPITAL & REGIONAL MEDICAL CENTER, Seattle, Washington
2002 - HAMILTON HEALTH SCIENCES MCMaster CHILDREN’S HOSPITAL, Neonatal Unit, Hamilton, Ontario
2003 - MCGILL UNIVERSITY HEALTH CENTER, Montreal General Hospital, Montreal, Quebec
2004 - ADULT
ICU Citation Winners
25 Years of Winning Designs

2005
ARAKANS CHILDREN'S HOSPITAL
Little Rock, Arkansas

2006
THE CHILDREN'S MEDICAL CENTER OF DAYTON
Dayton, Ohio

2007
MEMORIAL SLOAN KETTERING CANCER CENTER
New York, New York

2008
UNIVERSITY MEDICAL CENTER UTECHT
Utrecht, The Netherlands

2009
THE CHRIST HOSPITAL
Cincinnati, Ohio

2010
FOOTHILLS MEDICAL CENTRE
Calgary, Alberta, Canada

2011
CHILDREN'S HOSPITAL LOS ANGELES
Los Angeles, California

2012
PENN PRESBYTERIAN MEDICAL CENTER
Philadelphia, Pennsylvania

2013
2014
2015
2016

2016 ICU Design Competition Winner
Penn Presbyterian Medical Center
Philadelphia, Pennsylvania, USA
ICU Citation Winners
Honourable Mentions & Additional Applicants
ICU Citation Winners
Honourable Mentions & Additional Applicants
SCCM - ICU Design Competition
25 Years of Winning 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
SCCM - 2011 Winning ICU Design Video
Utrecht Medical Center, The Netherlands
Critical Care Units – Trends in Winning Designs

2009 World Health Design

2013-2016 ICU Citation Winners
New Construction versus Renovation

- **2013**: 11 ENTRIES
- **2014**: 6 ENTRIES
- **2015**: 3 ENTRIES
- **2016**: 10 ENTRIES
2013-2016 ICU Citation Winners
Unit Typologies

- 2013: 11 ENTRIES
- 2014: 6 ENTRIES
- 2015: 3 ENTRIES
- 2016: 10 ENTRIES

Legend:
- CARDIOVASCULAR ICU
- NEURO ICU
- PEDIATRIC & NEONATAL ICU
- BURN ICU
- MEDICAL/SURGICAL ICU
2013-2016 ICU Citation Winners
Life Support Systems

- BOOM: 30 entries (40%)
- HEADWALL: 1 entry (3%)
- POWER COLUMN: 0 entries (57%)

1. Patient Zone
2. Family Zone
3. Hygiene Zone
4. Clinical Zone
5. Charting Sub-Station
6. Ceiling Height: 9' to 11' (2.7m to 3.3m)
7. Clearance: 8' to 10' (2.4m to 3.0m)
8. Clearance: 7' to 9' (2.1m to 2.7m)
2013-2016 ICU Citation Winners
Overall Unit Size

<table>
<thead>
<tr>
<th>Year</th>
<th># Beds</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>48</td>
</tr>
<tr>
<td>2014</td>
<td>58</td>
</tr>
<tr>
<td>2015</td>
<td>120</td>
</tr>
<tr>
<td>2016</td>
<td>26</td>
</tr>
</tbody>
</table>

Average: 36
2013-2016 ICU Citation Winners
Patient Room Size

ROOM SIZE
SQUARE FEET (SF)

220
370
300
270
260
320
172
259 SF AVG

2013 2014 2015 2016
Intensive Care Unit Design
Future Trends

1. Larger Units
2. Patient Rooms
3. Staff Environment
4. Technology
5. Changing Practices

2008 ICU Design Competition Winner
Emory University Hospital
Atlanta, Georgia, USA
Intensive Care Unit Design

25 Years of Winning Trends

European Healthcare Design Congress
London, United Kingdom
June 27, 2016

http://www.sccm.org

Diana Anderson, MD, MArch
Dochitect, Stantec Architecture
diana.anderson@stantec.com
Critical care design of tomorrow: how technology fits in

Neil A Halpern MD, MCCM, FCCP, FACP
Chief Critical Care Medicine
Memorial Sloan Kettering Cancer Center, NYC
Agenda

Medical devices
Cybersecurity
IT Sim Lab
Dark data & future proofing
Medical devices

Past: medical devices were just devices with defined tasks
  – Physiological monitor - counted heart beats
  – Mechanical ventilator - pushed air
  – Infusion pump - pumped fluid

Now: medical devices are complicated, sophisticated, costly, informatics platforms
Infusion Pump: The Dark Ages

One-time Purchase
Infusion Platform: The Modern Era

Middleware
- Pump
- Memory
- EMR

Infusion Pump: The Dark Ages
- Memory Access
- Offsite Backup
- Pump Server?

VPN Access
- Privacy
- IT Security
Implementing Infusion Pump System

- Medication Library
- Dosing Protection
- Medication Orders
- Alerts
- Wireless Communication
- Memory
- Back-up
- Privacy
- Handhelds
- IT Security
Infusion Platform: The Modern Era

- Middleware
  - Pump
  - Memory
  - Pharmacy
  - EMR

- Offsite Backup Pump Server

- VPN Access

- Web Portal

- Access Point

- Software Updates
- Security Updates
- Medication Orders
- Dosing Protection
- Medication Library

- Wireless Communication
- Alerts
Infusion Platform: Costs

Ongoing Costs for Software Updates & Licenses
Cybersecurity: Real or a Joke?

Hawaii
Hospital hacker attacks

Historically: Obtain pt records for fraud schemes

Current: Digital extortion racket
– Paralyze the hospital
– Demand economical ransom
Time to look for a new hospital to hack!

What's this email or weblink? Let's click on the link…

Can't get in the front door, let me get in the back door!

Let's revert to paper now!

Time to look for a new hospital to hack!
Recently Hacked US Hospitals

Hollywood Presbyterian, LA; single stand alone
   – Paid 17G in Bitcoin

Methodist Hospital, Henderson, KY
   – Restored data from back-ups/paid 18G

MedStar Health System, Columbia, MD, 10 hospitals
   – $18,500 to restore system
Basic hospital IT protection

What can we hack today?

That was easy!

I’m sure the firewall will protect us.

I’m sure signature-based protection and antivirus software will protect us.
Why MEDJACK/Hack medical devices?

Medical devices:
- Connected to hospital network
- “Black boxes” to the hospital
- Not amenable to common cyber defenses
- No one knows when infected

Med device companies:
- Not trained or skilled to handle complex CS issues
- Devices run out of date & insecure OS

TrapX Security (www.trapx.com)
recreated recent attacks in Sim lab
- Studied: Infusion pumps, PACS, POCT analyzers
- Easily hacked & data manipulated
FDA Cybersecurity Guidelines

Dating back to 2007, most current...

Draft Guidance for Industry. “Moving Forward: Collaborative Approaches to Medical Device Cybersecurity”

Distributed for comment. Jan 22, 2016, Federal Register, Vol 81, Issue 14
Annual FDA Cybersecurity Guidelines for Medical Devices

Challenging to address CS threats
Cannot completely eliminate them
Shared responsibilities between manufacturers & hospitals to be vigilant in assessing threats, risk levels & mitigating them
Hospitals to evaluate & protect their networks
FDA does NOT need to typically review/approve medical device CS software changes
What can a hospital or device company do?

Wake up, make CS a priority
Recognize CS failure is a pt care issue
Evaluate existing & new systems
Don’t try and monitor yourself
  – Hire chief information security officer
  – 24/7 external security operations center to monitor hospital
Build an ITSim Lab

With identical systems as ICU & hospital
Obtain & test ALL prioritized technologies (new devices, Apps & upgrades) in real-life settings
  – Function, connectivity,
  – Interoperability & security
Dark Data & Future Proofing
Conclusions

Appreciate the integral role IT plays in the ICU design of tomorrow
Recognize that medical devices are informatics platforms
Prioritize cybersecurity
Test everything in an ITSim Lab
Cautiously embrace the IT future
Thank You!