Convergence of Surgery and Medical Imaging: facility design as a catalyst for cultural change

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1. Facility design as a catalyst for change

2. Convergence of surgery and imaging and the culture of safety

3. Design based on evidence and best practices
Facility Design as a Catalyst for Change
Prototype Design

Does the design of contemporary surgical and interventional radiology suites respond to recent changes in how these services are now practiced?

OR & Imaging Rooms, circa 1900

Packing watermelons, circa 2000
Surgical and interventional procedures have changed dramatically in recent decades and in many ways are converging.

Why do the designs of “surgical” suites and “interventional” suites remain so different?

What new design models should be considered?
Surgery becoming less-invasive

Reliance on advanced image guidance

Increased electronics / IT (dedicated closets)

Tech runs image guidance devices (control room)

Imaging becoming more interventional

“Surgical-like” procedures

“Surgical-like” HVAC

Increased Prep / Recovery needs (PACU)
Disrupting a Tradition of Separation

- From competition to collaboration
- From turf battles to resource sharing
- From separation to inclusion
INTEGRATED INTERVENTIONAL PLATFORM: The consolidation of various interventional services within a common area and operated as an integrated program.
Impact of Technology on Culture

Advanced medical technology ....

.... can accelerate or disrupt collaboration.
Form Not Following Function

OR integration systems . . .

... do they belong within the operating room? .
Form Evolving from Changes in Practice

Operating Room with Control Room (OR as Cath Lab)

Support Team

Supplies

Patient

Scrubbed Team

Electronics

Control Room
Procedure Rooms with Control Rooms
Convergence of Surgery & Imaging, and the Culture of Safety
Work Flow Differences

**Surgery:**
- Flow often follows “clean-core” layout
- Mostly re-usable supplies
- Frequent use of case-cart delivery systems
- Strict surgical protocol for scrubbing, masks, etc.

**Interventional Radiology:**
- Flow often follows “staff-core” layout
- Mostly disposable supplies
- Infrequent use of case-cart delivery
- Protocol often seen as a nuisance
MRI in the OR: Location Considerations

**Surgical Location Considerations:**
- Controlled surgical access
- Convenient supply/return of sterile instruments and supplies
- Proximity to prep/recovery beds
- Proximity to anesthesia

**MRI Location Considerations:**
- Occasional non-surgical access to MRI
- Restricted (safety) access to MRI
- Distance to other devices affected by magnetic and/or RF interference
- May desire “street clothes” access
ACR MRI Safety Guidelines

ZONE 1: Unrestricted
[outside MR suite]

ZONE 2: Restricted to supervision by MR personnel
[reception, waiting, toilets, dressing]

ZONE 3: Highly restricted area where serious injury can occur
[control room, computer room]

ZONE 4: Most highly restricted where all non-MR personnel must be in direct visual supervision of Level 2 MR staff at ALL times
[MR scanner room]
MR/OR in One Integrated Room

RF shield entire room

Imaging and Procedure Zone
(MR compatible surgical instruments)

Stationary Magnet

Image: courtesy of Brigham and Women's Hospital
MR/OR in One Integrated Room

RF shield entire room

Imaging Zone

Procedure Zone

“Pivoting” Magnet

Image: BrainLab
MR/OR in One Integrated Room

“Pivoting” Magnet
MR/OR in One Integrated Room

RF shield entire room

Traveling Magnet
MR/OR in One Integrated Room

RF shield entire room

Traveling Magnet

Courtesy of Stantec Architects, Ltd. Calgary, AB
MR/OR in One Integrated Room

RF shield entire room

Imaging Zone

Procedure Zone

Traveling Patient

Image: University of Minnesota
Daylighting the Deep Floor Plate

- "Technology-driven" departments do not need to be deprived of natural daylight
- Create "areas of respite" for staff and "areas of solace" for patients and families
- Separate "off-stage" staff zones from "on-stage" patient zones
The Integrated Interventional Platform

“Day-lighting” the deep floor plate

Borrowed light from exterior into corridors

Borrowed light from interior courtyards into corridors

Borrowed light from corridors into procedure rooms
Case Study

800,000 SF Replacement Hospital:

**Hospital (183 Beds) 670,000 SF**
- 183 Pediatric Beds
- 70 Adult Oncology Beds
- 36 L/D Beds
- 20 Operating Rooms
- 6 Cath Lab/IR Rooms
- 3 Endoscopy
- 18 Diagnostic Imaging Rooms

**Outpatient 160,000 SF**
- 92 Pediatric Exam Rooms
- 8 Adult Oncology Exam Rooms
- 41 Women’s Exam Rooms

**Central Utility Plant 35,000 SF**
“Braided Identities”
“Braided Identities”
One of the Most Sustainable US Hospitals

WARNING
This Area Contains Chemicals Known To The State Of California To Cause Cancer, Birth Defects, and Other Reproductive Harm.
California Health and Safety Code Section 25249.6
Creating a Culture of Pediatric Safety

adult identity & culture of safety

children’s identity & culture of safety

separate adult and children’s worlds
Creating a Culture of Change

Adult Procedures

Future Technology Zone

Pediatric Procedures

Daylight

OR OR OR OR OR OR OR
OR Cath Core OR OR
OR Cath Angio OR Core OR
OR OR Angio MRI OR OR
OR OR Cath Core OR OR
OR OR OR OR OR OR OR
Radiology Reading Room Design

Improperly designed reading environments contribute to:

- Reduced radiologist accuracy (misdiagnoses)
- Reduced radiologist productivity (inefficiency)
- Increased workplace injuries (hands, neck, eyes, headaches)
Tradition of Non-designed Reading Room

- Typically, the reading room is not designed
- Often specified as an office work space, with inappropriate lighting, materials and finishes
- Reading activities appear to be misunderstood
Transition from Film to Soft-copy

- Reading activities become more intense
- 3D & 4D images; reading is more interactive
- Room design becomes more critical
Reading Room Prototype

Lighting

Acoustics

Enclosure

Ergonomics
Reading Room Prototype
Reading Room Prototype
Design Based on Evidence and Best Practices
Three Levels of Research

**Internal Knowledge Dissemination:**
shares the extensive expertise already possessed by our diverse staff to expand the skills and understanding of others within the firm.

**Acquisition of External Knowledge:**
examines what we can learn from others – our clients, our peers and from other professions – to further expand our internal knowledge.

**Focused Research:**
used selectively to study issues at the forefront of architecture, healthcare and medicine.
Energy Performance Tools

Energy efficiency begins with an architectural energy efficient concept that focuses on:

- Designing the building envelope to lower the loads and make renewable fuel systems affordable.

- Integrated approach to allow downsizing mechanical systems, save energy and reduce building cost.

- Architects’ core competence to design the building to meet or exceed energy performance benchmarks.
Flight-ready Checklist for Design

Flight Ready Checklist of Best Practices

Phase: ANSHEN + ALLEN

Project Name: Project Number:

Does project provide the following? If not, do not proceed to next design phase w/o a clear strategy.

- **PATIENT/STAFF SAFETY**
  - Visibility of patients
  - Ceiling lifts (patient rms)
  - Non-toxic materials
  - ACR MRI safety
  - Interview Radiation Physicist
  - Interview Chief Safety Officer
  - Design w/ safety policies

- **PATIENT/STAFF EXPERIENCE**
  - Clear wayfinding
  - Daylight @ interior
  - Patient privacy
  - Artwork strategy
  - Operable windows
  - On-stage / off-stage
  - Noise reduction
  - Short travel distances
  - External views
  - Patient choices
  - Convenient parking
  - Staff Respite

- **REDUCED MEDICAL ERRORS**
  - All private patient rms
  - Convenient sinks and gel
  - Robust air and ventilation
  - HEPA filtration strategy
  - Interview Infect. Control staff
  - Materials selection strategy

- **REDUCED INFECTION RATES**
  - Low-distract pharmacy
  - Low-distract meds rooms
  - Convenient consult spaces
  - Lighting design strategy
  - Communications syst. strategy

- **OPERATIONAL EFFICIENCY**
  - Separate flow (pts, staff, mtrls)
  - Separate flow (IP/OP)
  - Separate flow (adult/child)
  - Nursing unit configuration strategy
  - Remote support strategy
  - Vertical transport analysis
  - Adequate parking by type
  - Supply inventory strategy

- **LIFE-CYCLE FLEXIBILITY**
  - External expansion strategy
  - Internal conversion strategy
  - Excess capacity of bldg systems
  - Adequate flr-to-flr height
  - Column bay spacing strategy
  - Modular prop/planning
  - Bldg sys zoning: horiz
  - Bldg sys zoning: vert

- **FINANCIAL PERFORMANCE**
  - Energy performance modeling
  - Best practice dgsf & bgsf multi
  - Best practice dept program allocations
  - Best practice flr-to-flr
  - 1st cost/life cycle strategy
  - Philanthropy strategy

- **BEST PRACTICE CONCEPTS**
  - Acuity adaptable rms
  - Acuity-convertible rms
  - Handed patient rms
  - Integrated Interventional
  - Other:

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RESEARCH PRIORITIES FOR INVESTIGATING THE IMPACT OF DESIGN ON OUTCOMES:

1.  
2.  
3.  
4.  

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Flight-ready Checklist for Design
I said *heel*, not heal. *Bad dog. Bad dog.*