A Smarter Operating Room

Key Trends in OR Technology

February 10\textsuperscript{th}, 2014
Road Map

1. Trends in OR Construction
2. Facilitating Multidisciplinary Collaboration
3. Investing in a “Smart” OR
4. Impact of Investing
Health Care Construction A Priority

Physical Construction, Technology Investments Both Set to Grow

Percent of Capital Budget Allocated to Construction

- New Construction
- Facility Renovation
- Facility Infrastructure

<table>
<thead>
<tr>
<th>Year</th>
<th>New Construction</th>
<th>Facility Renovation</th>
<th>Facility Infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008</td>
<td>25%</td>
<td>17%</td>
<td>21%</td>
</tr>
<tr>
<td>2009</td>
<td>35%</td>
<td>16%</td>
<td>14%</td>
</tr>
<tr>
<td>2010</td>
<td>38%</td>
<td>35%</td>
<td>14%</td>
</tr>
<tr>
<td>2011</td>
<td>22%</td>
<td>21%</td>
<td>14%</td>
</tr>
<tr>
<td>2012 (budgeted)</td>
<td>16%</td>
<td>14%</td>
<td>14%</td>
</tr>
</tbody>
</table>

11% Percent of hospitals with active surgery construction

16% Percent of hospitals with planned surgery construction

Sources:
New ORs a Selling Point to Surgeons, Patients Alike

Improvements in Capacity, Patient Outcomes, Efficiency, Productivity

Leading Reasons for Hospital Investments in ORs

**Operational**
- Increase Capacity
- Update Facility
- Increase Efficiency, Productivity

**Competitiveness**
- Enable Medical Training
- Surgeon Recruitment
- Increase Perception of Hospital as Progressive

**Quality**
- Improve Patient Outcomes
- Encourage Surgical Innovation

Source: Technology Insights research and analysis.
Operating Rooms Are the Heart of the Hospital

ORs Account for High Percentage of Total Hospital Cost, Revenue

- OR Costs: 65%
- Other Hospital Costs: 35%
- OR Revenue: 40%
- Other Hospital Revenue: 60%

Inpatient Surgery Contribution Profit

- Neurosurgery Trauma: $60K
- Tracheostomy: $50K
- Lung Transplant: $40K


1) National Medicare Average
Cost of OR Upgrades is Significant

Big Ticket Items like Imaging and A/V Equipment Add Up

Cost of Constructing or Renovating ORs

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction of a new building or room</td>
<td>$200-$250 per square foot</td>
</tr>
<tr>
<td>Imaging equipment</td>
<td>Fixed C-arm = ~1.3M</td>
</tr>
<tr>
<td></td>
<td>Mobile= 160-200K</td>
</tr>
<tr>
<td>Laparoscopic equipment</td>
<td>$1,500-$2,000</td>
</tr>
<tr>
<td>Robotic equipment</td>
<td>$1.0-$2.5M</td>
</tr>
<tr>
<td>Integrated OR set-up</td>
<td>$300K+</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$2M-$3M per OR</strong></td>
</tr>
</tbody>
</table>

Potential Impact of Improved OR Efficiencies

$4-7M Added annual revenue from adding one case per day to an OR

Historic Solutions Focus on Room Design

Large, Cluttered Spaces Inhibit Easy Staff Movement

Key Considerations for Room Layout

Challenges
- Staff complain about large room requiring lots of walking to retrieve instruments
- Addition of imaging equipment, surgical instruments, and A/V devices can clutter an OR

Interim Solutions
- Locate instruments no more than a 60-second walk
- Elevate equipment to reduce clutter and maintain efficient workflow

Source: Technology Insights research and analysis.
New ORs Feature Connectivity, Collaboration

Hospitals Pursuing Two Trends in OR Design

1. Designing ORs to facilitate multidisciplinary collaboration on progressive interventions

2. Building integrated, “Smarter” ORs
Road Map

1. Trends in OR Construction

2. Facilitating Multidisciplinary Collaboration

3. Investing in a “Smart” OR

4. Impact of Investing
ORs Bring Surgeons Together on Complex Cases

Interventions Increasingly Requiring Multidisciplinary Expertise

Example of Multidisciplinary Support on GERD Treatment

Surgeons
- General Surgeon
- GI Surgeon

Technology
- Laparoscopic equipment
- Endoscopic equipment

Imaging
- Laparoscopic camera
- Endoscopic camera

MIS Technique
- Laparoscopic access to surgical site
- Endoluminal surgery

Fluoroscopy

Source: Technology Insights research and analysis.
Hybrid Suites Bring Team-Based Care to The OR

Complex Hybrid and MI Procedures Warrant Specialty Collaboration

- Percutaneous devices are larger, thicker than previous technologies
- Examples: AAA\textsuperscript{1} stent grafts, percutaneous valves

- Surgical procedures are moving more minimally invasive
- Examples: Robotic MV\textsuperscript{2} repair, MIDCAB\textsuperscript{3}
While Expensive, Fixed Imaging ORs Still Popular

To Justify Costs, Many Specialists Must Have Access to ORs

Construction Costs for Specialty ORs

- **iCT**: $1.3 M
- **iMRI**: $2.5 M
- **Hybrid OR**: $3+ M

Specialty OR Installations

- **100 iMRIs** installed worldwide
- **100 Hybrid ORs** installed nationwide
- **10 iCTs** installed nationwide

Source: Technology Insights research and analysis.
Universal OR Model Gaining Steam

Availability of Imaging and Surgical Modalities Allow Flexibility of Rooms

Defining the Universal OR Concept

Sterile Operating Setting
Sterility is a definitional feature of an operating room, even if components of some multidisciplinary procedures performed in this setting do not require sterility.

Fixed or Mobile Imaging Available
Fixed or mobile imaging systems—such as angiography, intraoperating CT, and fluoroscopy provide imaging used by several specialties.

Surgical Modalities Available
Laparoscopic, endoscopic, robotic, and/or other surgical modalities are available within the room as a fixed feature, or can be wheeled in on a mobile cart.

Universal Infrastructure
Infrastructure that allows for many specialties to use the room—for example, universal tables—is key to the flexibility of these rooms.

Source: Technology Insights research and analysis
OR Layout Aims for Greater Efficiency

Immediate Accessibility of Instruments Required by Variety of Specialists

Central Location of Instruments in OR Layout

Central Sterile Processing Critical to OR Efficiency

- A wide range of instruments must be available in operating suites that house a variety of surgical specialties
- Many hospitals find it most convenient to locate sterile processing centrally in the building
- However, other hospitals achieve greater accuracy and efficiency by sending instruments off-site to be reprocessed and prepared the night before for a day’s cases

Source: Technology Insights research and analysis.
Future Innovation Depends on Current Flexibility

ORs Can Be Adapted to Accommodate Emerging Interventions

<table>
<thead>
<tr>
<th>Advantages of Universal OR</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong></td>
</tr>
<tr>
<td>Specialty ORs</td>
</tr>
<tr>
<td>Allows advanced interventional—but potentially low volume—procedures for one specialty</td>
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<td></td>
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<td></td>
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<td></td>
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</tbody>
</table>

Source: Technology Insights research and analysis.
Road Map

1. Trends in OR Construction
2. Facilitating Multidisciplinary Collaboration
3. Investing in the Next Generation “Smart” OR
4. Impact of Investing
ORs Designed as Adaptable Platform for Future Technology Additions

Sample Smart OR Features

- Elevated booms
- Imaging systems
- Surgical technology
- Computer
- Digital records
- Intra-room connectivity
- Touch screens
- Voice recognition
- High definition video

“Integration” the Key Concept Behind Smart ORs

- OR integration involves centralizing, connecting, and elevating onto booms all technology, equipment, and tools
- Routing, recording, transmitting, and storing data are key functions of OR integration
## Smart OR Technology

### Basic features of integrated ORs
- Procedures are recorded on video and displayed on HD monitors
- 3D video available
- Video can be transmitted outside of the OR

### Emerging features of integrated ORs
- Surgeons can consult with others outside of the OR in real time
- Surgeons can access images and records immediately
- Data collected during procedures is stored in the cloud and easily accessible

### Basic OR
- Patient records created and stored in paper format
- No video recording of procedures
- Monitors for visualization of surgical site are basic

### Video Capabilities
- Procedures are recorded on video and displayed on HD monitors
- 3D video available
- Video can be transmitted outside of the OR

### Inter-connectivity
- Surgeons can consult with others outside of the OR in real time
- Surgeons can access images and records immediately

### Cloud Storage
- Data collected during procedures is stored in the cloud and easily accessible

### EMR Integration
- Patient data is integrated into the electronic medical record

Other available add-ons to Smart ORs include telemedicine capabilities and remote support from vendors.

Source: Technology Insights research and analysis
“Plug and Play” Devices Many Hospitals’ Priority

Hospitals Insist on Flexibility in Incorporating Several Vendors’ Products

Options for Vendor-Customized ORs

- Hospital A negotiates with vendors to ensure that devices can interplay with other products.
- Hospital B developed custom archived records system in the OR with a vendor.
- Hospital C partnered with a vendor on a hybrid OR pilot.

Level of partnership with vendor

CIMIT “Plug and Play” Initiative

- The Center for Integration in Medicine and Technology (CIMIT) leads an interdisciplinary, multi-institutional program dedicated to advancing medical device interoperability.
- The goal of the initiative is to network device systems to spread the use of data, produce comprehensive medical records, and ultimately reduce preventable errors and health care costs.

Source: Center for Integration in Medicine and Technology website, http://www.cimit.org/programs-mdplugandplay.html; Technology Insights research and analysis.
Unprecedented Information at Surgeon’s Fingertips

Data Ubiquity Can Increase Speed and Improve Quality of Operation

Benefits of Additional Information

- Surgeons can call up patient history or lab results immediately
- Surgeons can consult with peers in real time
- Surgeons can record video to stream live or to show later for teaching purposes

Information Overload

- Hospitals may find that too much information technology in ORs can exceed surgeons’ ability to manage competing inputs
- Some surgeons working in Smart ORs refrain from using all of the tools at their disposal, like touch screen or voice recognition technology, preferring to delegate to nurses to pull up information on their behalf

1) Includes hospital, skilled nursing facility, hospice, and home health services; excludes physician services.
2) Disproportionate Share Hospital.

Source: Technology Insights research and analysis.
Homegrown Dashboard Improves Efficiency

Multidisciplinary Review of Utilization Ties Performance to Compensation

Metrics Tracked in One Hospital’s Perioperative Dashboard

<table>
<thead>
<tr>
<th>Metrics</th>
<th>![Checkmark]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Case hours</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Case volumes</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Turnaround time</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Staff utilization</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>Procedure time</td>
<td>![Checkmark]</td>
</tr>
<tr>
<td>On time starts</td>
<td>![Checkmark]</td>
</tr>
</tbody>
</table>

Power of the Perioperative Dashboard

- Set of metrics tracked in daily reports generated from the perioperative dashboard used to continually assess progress, convene staff to discuss avenues for improvement, and further increase efficiency

Source: Technology Insights research and analysis.
Culture of Accountability Maintains Time Start Rate

75% On-Time Starts For 4 Years an Organization Goal

Aligning Resources and Executive Support to Hardwire Change

**STAR 1 Center**
A focused center to achieve maximum readiness for surgery, using anesthesia assessment guidelines

**OR Daily Huddle**
Senior VP of Surgical Services, OR Staff, Surgeons and Anesthesia review-first start delays daily to determine root cause

**Culture of Accountability**
Results of “Daily Huddle” shared in a public email including the CEO and Medical School Dean

% On Time First Case Starts, Patient In University Medical Center

- **2006**: 52%
- **2007**: 60%
- **2008**: 56%
- **2009**
- **2010**
- **2011**: 81%
- **2012**: 80%

Academic Medical Center Cohort’s On Time Starts %, PI
Cohort 90th Percentile = 70%
Cohort 75th Percentile = 58%

Goal Achieved

1) STAR: Scheduling, Testing, Assessment, and Registration

Source: Cohort Benchmark Version: Academic Medical Center Cohort 2012
Real-Time Alerts on Patient Status Lower Anxiety

Nurses and Families Appreciate Up-to-Date Knowledge

Real-Time Patient Status Updates

OR1: Patient A — 5 min
OR2: Patient B — 15 min
OR3: Patient C — 45 min
OR4: Patient D — 60 min

1
Video monitors alert staff that patients are ready to be moved to recovery and that OR ready to turn over

2
Updates on patient status alert family that their loved ones are almost done with procedure

Source: Technology Insights interviews and analysis.
### Automated System Eliminates Anesthesia Abuses

**Efficiency from Automated Medication Distribution, Electronic Records**

#### Impact of Automated Anesthesia System

<table>
<thead>
<tr>
<th>Flaws in Old System</th>
<th>Fixes in New System</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time-consuming manual process of entering records into system</td>
<td>Paperless records faster to enter, more accessible in electronic format, integrated with EMR</td>
</tr>
<tr>
<td>Old system inefficiently distributes medication, subject to user error</td>
<td>Pyxis works like an ATM to automatically dispense medication</td>
</tr>
<tr>
<td>Insecure system cannot prevent drug diversion</td>
<td>Pyxis tracks medication distribution to patients by provider and by time, preventing abuses</td>
</tr>
<tr>
<td>Medication ineffectively tracked, leading to lost billing opportunities</td>
<td>Pyxis records ensure medication attributed to correct case</td>
</tr>
</tbody>
</table>

#### Pyxis in Brief

Carefusion’s Pyxis system is an anesthesia medication management system used in the operating room

Source: Technology Insights research and analysis
Supply Cost Tracking Show Surgeons Their Costs

Instrument Scanning Stores Physician Preferences, Per-Case Costs

Savings from Supply Cost Tracking in OR

- **Cost per case calculated**
- **Surgeons visualize costs of their cases and compare against peers**
- **Savings calculated**

Data Collection

- Instruments scanned at point of use

Data Analysis

- Costs tracked at line-item, CPT, and service line level

Data Visualization

- Cost transparency helps eliminate physician preference items, standardize supplies, reduce waste

Cost Reduction

Impact of Improved Supply Tracking at One Hospital

$4M Savings in supply costs over three years

1) Bundled Payments for Care Improvement.

Source: Technology Insights research and analysis.
“Smart” ORs Not Actually Intelligent

Smart OR Platform Has No Predictive Capability

“Smart OR” May Be Flawed Term

- Smart ORs integrate unprecedented information and technology into an OR
- ORs lack predictive, intuitive capabilities
- Future innovations may bring truly “smart” technology that can recognize patterns, anticipate needs, and automate processes
Road Map

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4. Impact of Investing
Important to Anticipate Staff Resistance to Change

Once Learning Curve Surmounted, Staff Realize Efficiencies Gained

Sample Learning Curve for Robotic Surgery Cases

<table>
<thead>
<tr>
<th>Cases before staff surmount learning curve</th>
<th>Assumed increase in set-up time during the learning curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>10-20</td>
<td>50%</td>
</tr>
</tbody>
</table>

Challenges to Adopting New Processes

- Nurses and operating room staff increasingly called upon to become comfortable with new technology
- Staff can be resistant to changing familiar ways of operating, like room set-up and clean-up, or writing records manually
- Choosing a vendor with a user-friendly interface that offers strong training and troubleshooting support is critical to making staff comfortable with new technology
- Anticipating staff frustrations and communicating importance of implementing new process is key to gaining buy-in until staff can see efficiencies gained after the transition
Involve Staff In Performance Improvement Process

Exposing Staff to Data Can Motivate Change

Success Factors in Maximizing Operating Room Utilization

1. **Gain Stakeholder Buy-In**
   - Convening a multidisciplinary group of surgeons, nurses, anesthesiologists, and administrators leads to consensus on goal of maximizing OR utilization.

2. **Define Metrics for Success**
   - Identification of metrics to track utilization and capacity in the operating rooms narrows scope of project.

3. **Track Performance**
   - Tracking performance allows continuous improvement.

4. **Review and Reassess**
   - Use of dashboard to generate daily reports raises staff awareness of performance, inspires staff to review reasons behind low performance, and can link performance and compensation.

Source: Technology Insights research and analysis.
# Identifying ROI on Initiatives a Challenge

Not Always Straightforward to Measure Progress on Goals of OR Redesign

## Challenge to Measure ROI of OR Overhaul

<table>
<thead>
<tr>
<th>Goal for OR Investment</th>
<th>Metric to Track</th>
<th>Measurability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increased Capacity</td>
<td>Higher daily total volumes</td>
<td>Easy</td>
</tr>
<tr>
<td>Improve Design</td>
<td>New patient volumes</td>
<td>Very Challenging</td>
</tr>
<tr>
<td>New Surgical Offerings</td>
<td>Novel procedures performed</td>
<td>Neither Challenging Nor Easy</td>
</tr>
<tr>
<td>Improved Patient Outcomes</td>
<td>Reduced complications, readmission rates, length of stay</td>
<td>Very Challenging</td>
</tr>
<tr>
<td>Improved Surgeon Training</td>
<td>Quicker ascendance of learning curve</td>
<td>Neither Challenging Nor Easy</td>
</tr>
<tr>
<td>Increased Efficiency</td>
<td>Higher daily total volumes</td>
<td>Easy</td>
</tr>
<tr>
<td>Improved Surgeon Recruitment</td>
<td>Selective surgeons choose hospital</td>
<td>Neither Challenging Nor Easy</td>
</tr>
<tr>
<td>Perception of Hospital as Progressive</td>
<td>New patient volumes</td>
<td>Easy</td>
</tr>
</tbody>
</table>

1) Bundled Payments for Care Improvement.
ORs Primed for Future Innovation

Multiple Vendors, Specialists Involved in Decisions

Key Trends in OR Design

1. Move from specialty-specific to universal ORs facilitates multidisciplinary procedures

2. Unprecedented information technology integrated into “Smart ORs”

3. Hospitals working with multiple vendors to incorporate interchangeable devices in “plug and play” model

4. Facility layout decisions enhance efficiency and maximize capacity

5. Technology allows tracking of efficiency, productivity, and cost metrics and integration of information with EMR systems