Are There Indicators to Determine Best Practice in HTM Programs?

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There are no conflicts related to a commercial entity and this presentation.
How do we define a Clinical Engineer?

Jack of All Trades?

A Juggler?
Clinical Engineering Roles

- Medical device regulations/policy
- Technology assessment
- Capital planning
- Product evaluation
- Project management
- Department administration
- Asset, maintenance and cost management
- Contract management
- Risk management
- Patient safety
- Retired equipment management

- Facilities support
- Medical device integration
- Operating clinical devices
- Product development
- Research support
- Applications engineering
- Incident investigation & expert witness
- Education (Academic) & Training (Institutional)
- Consulting
- And more.....
Role of Clinical Engineering in the Health Technology Life Cycle in Vermont USA
Clinical Engineering Indicators

• An indicator is an objective, quantitative measurement of an outcome or process that relates to performance quality.
  – Accessibility, appropriateness, continuity, customer satisfaction, effectiveness, efficacy, efficiency, safety, and timeliness.
  – Indicator is reliable if the same measurement can be obtained by different observers.
  – A valid indicator is one that can identify opportunities for quality improvement.
  – Can measure a process or outcomes
  – High-volume, high-risk, or problem-prone processes require frequent monitoring of indicators
Clinical Engineering Indicators

• Quality process
  – Define the indicator
  – Establishing the threshold
  – Monitor the indicator
  – Evaluate the indicator
  – Identify quality-improvement opportunities, and
  – Implement action plans
  – Feedback loop

Joint Commission

Bob Morris, BME Handbook
Clinical Engineering Indicators (USA & Italy)

- PM Completion
  - High Risk (100%)
  - Non-High Risk
- Tested before Patient Use/after repair (100%)
- Preventable Failures
  - Use error, No problem found, Damaged, Maintenance
- Failure Rate/reliability
- Downtime
- Repeat Repairs
- Response time
- Cost of service

- Frequency of failures
- Time of first intervention
- Time to resolution
- Average downtime
- Distribution of failure types
- Maintenance costs
- Cost of spare parts

Clinical Engineering Indicators (British Isles)

- Asset Management.
  - Analysis of Medical Device / Equipment
  - Asset Register.
  - Inventory compliance with database.
  - Frequency _ twice yearly.

- Measurements by quantity and value Plus age profile
  - total asset, new assets, decommissioned assets, % location change, % missing

Clinical Engineering Indicators (Egypt)

- Technical/Maintenance, Economic, Medical Equipment Acquisition, Criticality, Safety & Hospital
- 10 hospitals that cover different types of health care organizations
- Results - average gap of 67% between the CEDs' performance and the ideal target.

<table>
<thead>
<tr>
<th>Approach</th>
<th>No. of indicators</th>
<th>indicators type</th>
<th>Average performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Our approach</td>
<td>136</td>
<td>5 Basic hospital data. 13 technical/maintenance indicators. 12 Economic indicators. Equipment acquisition. Critical indicators. Safety indicators.</td>
<td>33%</td>
</tr>
<tr>
<td>Approach [1]</td>
<td>10</td>
<td>8 economic indicators. 2 maintenance indicators.</td>
<td>51%</td>
</tr>
</tbody>
</table>

Clinical Engineering Benchmarking

DEFINITION: A measurement of the quality of an organization's policies, products, or programs, and their comparison with standard measurements, or similar measurements of its peers.

• The objectives of benchmarking are to:
  – determine what and where improvements are called for
  – analyze how other organizations achieve their high performance levels, and
  – use this information to improve performance.

• Benchmarking is the use of indicators for comparison purposes
Clinical Engineering Benchmarking Bibliography


• Wang, B; Eliason, R; Richards, S; Hertzler, L; Koenigshof, S; Clinical Engineering Benchmarking: An Analysis of American Acute Care Hospitals, Journal of Clinical Engineering 2008

• Ted Cohen et al, Staffing Metrics: A Case Study, Biomedical Instrumentation & Technology, July/August 2011

• Binseng Wang, Clinical Engineering Benchmarking Comparison Between Zhejaing Province and American Hospitals, ICEHTMC
• Inventory
  • Risk levels, inspection procedures & frequencies, service costs, life expectancy, cost of service ratio
• Staffing
• Workspace
• Service contracts
  • Imaging, clinical laboratory, biomedical
• https://www.ecri.org/Products/Pages/BiomedicalBenchmark.aspx (USA)
• Anticipate equipment life cycles to improve efficiency
• Identify and evaluate options for equipment service
• Compare staffing levels to other similar facilities
• Determine if manufacturers' inspection frequencies can be reduced (USA)
### Table of IPM Procedure Frequencies

Many of the procedures provide additional guidance on inspection intervals.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>No.</th>
<th>Times/ Yr</th>
<th>Procedure</th>
<th>No.</th>
<th>Times/ Yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambulatory Infusion Pumps</td>
<td>490</td>
<td></td>
<td>Mini C-arms</td>
<td>478</td>
<td>2</td>
</tr>
<tr>
<td>Anesthesia Units</td>
<td>400</td>
<td>2</td>
<td>Mobile C-arms</td>
<td>463</td>
<td>2</td>
</tr>
<tr>
<td>Anesthesia Vaporizers</td>
<td>436</td>
<td>2</td>
<td>Mobile High-efficiency-filler Air Cleaners</td>
<td>475</td>
<td>6</td>
</tr>
</tbody>
</table>

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**High-risk devices:** Life-support, key resuscitation, critical monitoring, energy emitting, and other devices whose failure or misuse is reasonably likely to seriously injure patients or staff.

- Anesthesia Units and Vaporizers
- Apnea Monitors
- Argon-Enhanced Conagulation Units
- Irrigation/Distention Units
- Laparoscopic Insufflators
- Lasers (Surgical)

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### Device Term

<table>
<thead>
<tr>
<th>Device Term</th>
<th>Dev. Code</th>
<th>No. Data Points</th>
<th>Avg Service Cost ($/unit/yr)</th>
<th>Avg Acquisition Cost ($/unit)</th>
<th>Service Cost/Acquisition Cost (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acrators, Ethylene Oxide</td>
<td>10045</td>
<td>STD</td>
<td>$1,925</td>
<td>$19,399</td>
<td>9.9</td>
</tr>
<tr>
<td>Analyzers, Laboratory, Blood Gas/pH</td>
<td>15709</td>
<td>STD</td>
<td>$4,224</td>
<td>$43,311</td>
<td>10.3</td>
</tr>
<tr>
<td>Analyzers, Laboratory, Blood, Glycated Hemoglobin</td>
<td>17109</td>
<td>STD</td>
<td>$5,650</td>
<td>$69,806</td>
<td>10.2</td>
</tr>
<tr>
<td>Analyzers, Laboratory, Body Fluid, Amino Acid</td>
<td>15090</td>
<td>LTF</td>
<td>$10,800</td>
<td>$98,920</td>
<td>10.9</td>
</tr>
<tr>
<td>Analyzers, Laboratory, Body Fluid, Lead</td>
<td>15300</td>
<td>LTF</td>
<td>$6,350</td>
<td>$13,050</td>
<td>4.8</td>
</tr>
<tr>
<td>Analyzers, Laboratory, Breath, Carbon Dioxide</td>
<td>10558</td>
<td>LTF</td>
<td>$1,700</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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**Inspection Frequency**

**Risk Level**

**Service Cost**

**Acquisition Cost**

(USA)
AAMI Benchmarking Solutions—Healthcare Technology Management (USA)

• Web-based tool designed to help clinical engineering departments compare
  • Budgets, personnel, practices, and policies against other facilities
  • Number of devices maintained by a CE program
  • Percentage of scheduled inspections that identify a need for corrective maintenance
  • Internal or external comparisons
    – Differing bed, size, responsibilities, academic/community, location, adjusted discharges, acquisition cost, peer cluster
  • $900 each year ($800 AAMI member cost)
    – Data only - $2000 each year
• http://www.aami.org/abs
# AAMI Benchmarking Solutions—Healthcare Technology Management (USA)

## Staffing Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total FTEs</td>
<td>Total number of FTEs in the CE program.</td>
<td>17.00</td>
</tr>
<tr>
<td>Number of Clinical Engineers</td>
<td>Total number of clinical engineers (CEs) in the CE program.</td>
<td>2.25</td>
</tr>
<tr>
<td>Number of BMETs</td>
<td>Total number of biomedical equipment technicians (BMETs) in the CE program (FTEs).</td>
<td>14.00</td>
</tr>
<tr>
<td>Number of Other Personnel</td>
<td>Total number of other personnel (not CE or BMET) in the CE program (FTEs). Examples: clerical staff, contracts administrator, etc.</td>
<td>1.00</td>
</tr>
</tbody>
</table>

**Total of Above:** 17.25

**Expected Total:** 17

**Difference:** 0.25

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## Device Metrics

<table>
<thead>
<tr>
<th>Metric</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Devices - Total</td>
<td>Total number of all devices managed or maintained by CE.</td>
<td>10.325</td>
</tr>
<tr>
<td>Devices - Imaging and Therapeutic Radiology</td>
<td>Total number of all imaging equipment and therapeutic radiology equipment managed or maintained by CE. Examples: x-ray equipment, ultrasound equipment, CT systems, nuclear medicine systems, MR systems, linear accelerators, and other radiation treatment equipment.</td>
<td>138</td>
</tr>
<tr>
<td>Devices - Laboratory Equipment</td>
<td>Total number of all clinical laboratory equipment managed or maintained by CE. This category includes devices used for the preparation, storage, or analysis of patient specimens and pharmaceuticals.</td>
<td>295</td>
</tr>
<tr>
<td>Devices - General Biomedical Equipment</td>
<td>Total number of all the general biomedical equipment (devices not included in the two categories above) managed or maintained by CE. These are devices that provide monitoring, diagnosis, treatment, or life support. Examples: physiological monitors, infusion pumps, dialysis equipment, surgical equipment, scales, clinic equipment, ventilators, etc.</td>
<td>8,940</td>
</tr>
<tr>
<td>Devices - Other</td>
<td>Total number of all other devices (patient care and non-patient care devices not included in the three categories above) managed or maintained by CE. Examples: beds, stretchers, wheelchairs, nurse call systems, patient entertainment systems, general purpose computers, communications equipment, TVs, etc.</td>
<td>962</td>
</tr>
</tbody>
</table>

**Total of Above:** 10,325

**Expected Total:** 10,325

**Difference:** 0
AAMI Benchmarking Solutions—Healthcare Technology Management (USA)

• Reporting focusing on
  – Clinical engineering program overall performance
  – Devices
  – Cost of service ratio
    • Annual service cost = X %
      Acquisition cost
  – Staffing
  – Expenses
  – Operations
AAMI Benchmarking Solutions—Healthcare Technology Management (USA)

- Overall Cost of Service Ratio (3-8%)
- Clinical Engineering Dept $/Hospital Budget $ (~1%)
- Clinical Engineering Dept $/Adjusted Discharges (~$100 range)
- External Maintenance Costs/Maintenance Costs (25-85%)
- Hourly Cost of Service: Average (~$90/hour)
- Number of devices per technician (1057)
- Average Training Hours per technician (31 hours/year)
- Average Training Expense per Technician ($4521/year)
AAMI Benchmarking Solutions—Healthcare Technology Management (USA)
Staffing by Role (USA)

Staffing Allocation by Roles
My Facility

77%
15%
9%

Staffing Allocation by Roles
Average Facility

79%
12%
9%

2013 data
42 data sets
Advanced: Manages all HTM-related costs, operates like a business, has a CMMS with extensive analytical and technology management features, collaborates on the selection of all medical device-related technologies, integrates RM and QA methodologies, has a qualified clinical engineer on staff, provides leadership in CE-IT convergence issues for the organization, benchmarks externally, identifies best practices, and improves performance, is an active contributor to key technical and management groups in the organization, and provides leadership in national and regional professional associations.
Summary:

1. Clinical engineers bring value to healthcare in many ways – *jack of all trades but have to juggle priorities*
2. Clinical engineering practice has more similarities than differences worldwide, but global health system needs create dissimilarities in developing indicators
3. Studies have addressed indicators and benchmarking worldwide – *are we meeting our goals?*
4. Benchmarking systems are available with good assessment tools but have limited ability to compare programs globally