IMPROVING SURGICAL INSTRUMENT DELIVERY USING EXCEL-BASED OPTIMIZATION & PROCESS FLOW MODELING AT UMHS

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Outline

• **Background**
• **UMHS Case Study**
  – The Problem
  – Our Approach to Finding a Solution
• **Methods**
  – Literature Review
  – Process Flow Analyses
  – Cleanability Index
  – Instrument Set Reconfiguration
• **Implementation & Impact**
• **Conclusions & Next Steps**
  – Future Work, Research & Policy
BACKGROUND

Key Terms
- Surgical Instrument Reprocessing
- Reusable Surgical Instrument Cycle
Key Terms & Abbreviations

- **Surgical “Case”** – Surgery
- **O.R.** – Operating Rooms
- **CSPD** – Central Sterile Processing Department (instrument cleaning room)
- **Bioburden** – “dirt” (e.g. blood, bone, tissue…) on instruments from previous use
Efficiencies are a critical challenge for hospitals nationwide.

Involves multiple functions, resources, and stakeholders.

**UMHS:**
- 51,583 cases in FY14
- 65-70 cases/day
- 15,000 items processed/day
- “Colossal reprocessing operation”
• Surgical instrument cycle
  – From Purchase to Use

1) Instruments Purchased
2) Catalogued
3) Storage
4) Pulled for Use in O.R.
4.5) Cleaning at Point-of-use
5) Decontamination (Thorough Cleaning)
6) Assembled
7) Sterilization

Sets

Instruments
• Instruments are grouped together in predefined instrument “sets” or “trays”

• Instruments are classified by category

• Each category may have multiple sub-categories

*Tympanoplasty Instrument Set*
GOALS AND OBJECTIVES

UMHS Reprocessing Goal

Key Issues and Challenges

Our Approach to Finding a Solution
UMHS Reprocessing Goal

“To have all items required for the proper care of the patient available at the time of surgery, properly cleaned, sterilized, and in working condition – while ensuring the efficient use of resources.”
Key Issues & Challenges

• Frequent problems with reprocessing & delivery of instruments
  – Unavailable sets/items
  – Poorly functioning items
  – Insufficiently cleaned items (containing “bioburden”)

• ..And yet
  – 4 new O.Rs scheduled to open JUNE 2016
Impacts of Key Issues

• Institutional outcome measures not being met:

  - Safety
  - Quality
  - Timeliness
  - Financial Stewardship
  - People
Why Issues Exist?

• Some reasons why these issues exist?
  – **O.R. Volume** ↑
    • CSPD’s struggle to keep up
  – **Room Turnaround Time Pressure** ↑
    • O.R. Staff forgo point-of-use cleaning protocols
  – **Instrument Design Complexity** ↑
    • Each instrument has unique cleaning protocols (IFUs)
Our Approach

Objective 1: Understand UH’s reprocessing systems

Purpose
• Grasp and define current state processes

Methods
• Observations, Interviews
• Process Flow & Value Stream Mapping (incl. work time-studies)
• Historical Data Analyses
Findings & Contributions

1. Observed variations in Decontam processing times despite 15min/tray “productivity policy”
• It’s not the staff

• It’s the **system** & **policies**

• Creating an environment for adverse events
Findings & Contributions (cont.)

2. Identified, two major areas of opportunity for investigation:
   - instrument cleanability
   - instrument set configurations

3. Recognized, some instruments due to design features are
   - “more bioburden-prone” than others

4. Concluded, all instruments cannot be treated equally
   - harder-to-clean items require more cleaning time
Objective 2: Develop an “instrument cleanability index”

Purpose

- Create a systematic way of determining
  i. how hard-to-clean an instrument is (e.g. on a scale)
  ii. total distribution in any given set and associated impacts/tradeoffs

Methods +

- Literature Reviews
  - Content analyses of UMHS, FDA, & Industry policy guides
- Focus Group Surveys
  - Using Analytical Hierarchy Process (AHP)
Findings & Contributions

1. Developed a comprehensive “hard-to-clean design features list” – creating a standardized naming convention

2. Identified low-risk and high-risk instrument categories and their associated design features within the UMHS-NSA database

*Surgical bowl*  
**EASIER TO CLEAN**

*Retractor*  
**HARDER TO CLEAN**
Findings & Contributions (cont.)

3. Applied an adaptation of FDAs “Visualization & Access Framework” to understand the relationships of “hard-to-clean” design features
   - Discovered relationships are non-linear/non-additive

*Single-Hinge Kerrison*  
*Double-Hinge Kerrison*
Findings & Contributions (cont.)

4. Captured O.R. & CSPD staff members’ perceptions on the relative ease and difficulty of cleaning instruments
   - Identified positive correlations between staff perceptions and trending bioburden incident data
Objective 3: Develop an instrument-set configuration tool to decrease number of items sent back for reprocessing

Purpose

• Create tool to:
  i. Evaluate configuration impacts on the reprocessing outcomes
  ii. Recommend potential optimal set configurations

Methods ++

• Excel-based modeling
Implementation Process
Kerrison Separation Pilot Results
Reprocessing Workload Impact
Patient Safety Impact
Implementation: Steps 1-2

- Identify #1 Problem Set
- Target Hardest to Clean Items
  - Kerrisons
  - Suctions
  - Bipolar Forceps

Minor Neuro

Patient Safety Benefits Realized

Negotiations with Leadership

Reconfigured #1 Problem Set
### Implementation: Step 1-2

<table>
<thead>
<tr>
<th>Item Category</th>
<th>Aggregate Weight (lbs)</th>
<th>P(bioburden)</th>
<th># of Items</th>
<th>Items distributed correctly?</th>
<th>Mother Set</th>
<th>Subset 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>BIPOLAR (forcep)</td>
<td>0.17</td>
<td>0.60</td>
<td>4</td>
<td></td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>KERRISON (rongeur)</td>
<td>0.56</td>
<td>0.52</td>
<td>5</td>
<td>7</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>SUCTION</td>
<td>0.05</td>
<td>0.30</td>
<td>2</td>
<td></td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>

....
...
.
Implementation: Step 3-4

- Identify #1 Problem Set
- Target Hardest to Clean Items
- Kerrisons
  - Suctions
  - Bipolar Forceps

- Ensure Alignment with Leadership
  - Aligning: Surgeons, Nurses, CSPD Techs and Admin

- Reconfigure #1 Problem Set
- Kerrisons Separated Out

• Minor Neuro

• Patient Safety Benefits Realized
Reconfiguring Minor Neuro

Original Instrument Set
“Mother Set”

Reconfigured into 2 Instrument Sets
“Modified Mother Set & Subset 2”

Minor Neuro
Mother Set
(123 Instruments)
easier & harder to clean

Modified Mother Set
(118 easier-to-clean)

Subset 2
(5 harder-to-clean)
## Excel Tool User Interface

### Set Configuration Demo Tool

<table>
<thead>
<tr>
<th>Set Type Name</th>
<th>Set Type ID</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET, MINOR NEURO UH</td>
<td>500148</td>
</tr>
</tbody>
</table>

- **Initial Configuration**
  - **SET TYPE** | % sent back | # Instruments | Weight (lb) | # Categories | Original Tray Size | Std. Reprocessing Cost |
  - Minor Neuro | 12.5% | 123 | 22.33 | 22 | Large | $18.57 |

- **Reconfiguration Summary**
  - **SET TYPE** | % sent back | # Instruments | Weight (lb) | # Categories | New Tray Size | Std. Reprocessing Cost |
  - Minor Neuro Post-Separation | 6.8% | 118 | 19.53 | 21 | Large | $18.57 |
  - Kerrison Subset | 6.1% | 5 | 2.80 | 1 | Small | $9.29 |

- **All items distributed correctly?** | YES |

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**SO WHAT?**
Benefits observed associated with this intervention (2 months Review):

1. Decreased reprocessing workload due to bioburden by **54%**
2. Observed a **40%** reduction in potential patient harm incidents from Minor Neuro Set due to bioburden
3. **Zero BIOBURDEN** incidents observed/reported by O.R. since September 1, 2015 – YTD *(as of 10.31.15)*
4. Engineering approach to configuring sets (e.g., high-risk instrument separation) can yield increased efficiencies in production and quality
Institutional outcome measures positively impacted:

- Safety
- Quality
- Timeliness
- Financial Stewardship
- People

“every time we hear about bioburden, our hearts sink into our shoes... I was so afraid that this would only cause more bioburden and put all the pressure on me but we’ve had nearly zero incidents and people are no longer afraid to reprocess Minor Neuro!!! ~ CSPD NSA Lead Tech

“I am so proud to be a part of this team” ~ O.R. Manager

“The impact this team has achieved is incredible, and this is just ONE tray...” ~ UH OR Director

“When can this be applied to my sets?” ~ UMHS Ortho Surgeon
NEXT STEPS

Future Work
Future Work

• Refine and pilot cleanability index (Objective 2)
• Perform set-reconfiguration with sets beyond Minor Neuro
• Collect, analyze and publish findings and recommendations
• Contribute to the body of knowledge on:
  – Surgical Instrument Reprocessing
    • Inform purchasing-to-use
    • Set configuration impacts
  – Patient Safety
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Questions?

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