Process Optimization for Improved Delivery of Surgical Instruments

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Outline

• Motivation & Background
• Current Issues
• Solutions
  – Cleanability Index
  – Cleaning Time Estimation
• Future Work
• Questions
MOTIVATION & BACKGROUND

- Goals
- Key Terms
- Surgical Instrument Cycle & Reprocessing
“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.”

--Shawn Murphy, Director of OR Nursing
Key Terms

- **Bioburden**: Contamination by tissue from a previous surgical case (e.g. blood, bone)
- **CSPD**: Central Sterile Processing Department
- **OR**: Operating Room
- **Surgical Case**: Surgery
Surgical Instrument Cycle

1) Purchased
2) Catalogued
3) Grouped into sets
4) Stored in CSPD
5) Used & Cleaned in ORs
6) Decontaminated in CSPD
7) Assembled in CSPD
8) Sterilized in CSPD

Tympanoplasty Instrument Set
Surgical Instrument Reprocessing

- Industry-wide efficiency challenge

- Complicated & resource-intensive process

- Current state at UMHS:
  - 28 ORs
  - 51,000+ cases per year → 65-70 cases per day
  - 4,000 instruments processed per day
CURRENT ISSUES

- Contributing Factors
- Challenges
Contributing Factors

- Sets and instruments are not consistently available on time
- Workload will increase with 4 new ORs opening
- Not all instruments function correctly
- Sub-optimal supply of surgical instruments
- Instruments contain bioburden and/or debris

These issues lead to Surgery delays, potential hazards to patients, and excess workload for staff.
Key Issues

• Institutional outcome measures not being met:

- Quality
- Patient Safety
- Staff Satisfaction
- Timeliness
- Financials

Potential hazards to patients

Surgery delays

Excess workload
Current Challenges

- CSPD struggles to keep up with the demand
- OR staff forgo point-of-use instrument-cleaning protocol
- Each instrument has a unique cleaning protocol (IFU)
SOLUTIONS

Cleanability Index

Cleaning Time Estimation
Cleanability Index

**Goal**
Develop an instrument “Cleanability Index” (CI) for all Neurosurgery instruments

**Objectives**
Systematically determine:
- An instrument’s level of cleanability (e.g. 1-10 scale)
- A set’s level of cleanability based on its instruments
- Appropriate cleaning effort of each set

**Methods**
- Focus group surveys
- Instrument feature ranking games
- Analytical Hierarchy Process

Feature: Blade
Feature: Hinges
Findings and Conclusions

• With this information, we identified Neurosurgery’s low-risk and high-risk instruments (1.3%) and their associated design features.

• Preliminary analysis showed positive correlations between
  – Staff perceptions and trending bioburden incident data
  – Staff perceptions and hard-to-clean instruments identified by the CI system

• Results could be used to guide additional cleaning efforts.
Cleaning Time Estimation

**Goal**
Estimate time needed for high-quality cleaning

**Objectives**
Quantify time needed for:
- Bulk cleaning of easiest-to-clean instruments
- Additional cleaning of hard-to-clean instruments
- Soaking & ultrasonic cleaning

**Methods**
- Observations & time studies
- Excel-based modeling
Cleaning Time Estimation

Observations:
- 12 sessions across all shifts
- 26 videos filmed

Result times (Avg+1SD):
- Bulk cleaning: 5.2min
- Hard-to-clean instrument: 6s - 60s
- Soaking & ultrasonic: 20min
Findings and Conclusions

Most sets require around 30 minutes of cleaning time.

Cleanability Index highly correlated with hard-to-clean instrument cleaning time.

Variabilities between similar instruments and across different individual staff are surprisingly high.
### Cleaning Time Estimation

#### Instrument Set Dashboard Examples:

<table>
<thead>
<tr>
<th>Set Type Name</th>
<th>Set Type ID</th>
<th>Usage per Month</th>
<th>Initial Configuration</th>
<th>% sent back</th>
<th># Instruments</th>
<th>Weight (lbs)</th>
<th># Categories</th>
<th>Original Tray Size</th>
<th>Expected Cleaning Time</th>
<th>Cleanability Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>SET, MINOR NEURO UH</td>
<td>500143</td>
<td>143</td>
<td>Mother Set</td>
<td>12.5%</td>
<td>123</td>
<td>22.33</td>
<td>22</td>
<td>Large</td>
<td>37.76883343</td>
<td>184.95</td>
</tr>
<tr>
<td>SET, TRANSPHENOIDAL NEURO UH</td>
<td>500153</td>
<td>143</td>
<td>Mother Set</td>
<td>#VALUE!</td>
<td>94</td>
<td>0.00</td>
<td>25</td>
<td>Large</td>
<td>37.8052001</td>
<td>37.10</td>
</tr>
</tbody>
</table>


Potential Impact

• Institutional outcome measures potential improvements:

- Quality
- Patient Safety
- Staff Satisfaction
- Timeliness
- Financials
FUTURE WORK
Future Work

1. Standardize the cleaning procedures across CSPD technicians and similar instruments

2. Expand the Instrument Set Dashboard to other instrument sets beyond Neurosurgery

3. Use the Dashboard to identify additional bioburden-prone instruments
   - Separate these instruments to form a new set
   - Allow for more cleaning time to focus on such instruments
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Thank you!

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References

https://www.fau.eu/2015/06/15/news/recycling-clinical-instruments/
http://aesculapresourcecenter.com/
http://www.lindaremedical.co.uk/product/SurgicalInstruments_7_1.html