Systems Engineering Analysis of Graduate Medical Education (GME) Processes: A National Initiative

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1. **National Science Foundation (NSF)**

   *Center for Health Organization Transformation*
   
   • Industry/University Cooperative Research Center
   • Conduct research to support major management, clinical, and information technology innovations in healthcare

1. **Accreditation Council for Graduate Medical Education (ACGME): Pursuing Excellence in Clinical Learning Environments Program**

   • Four-year initiative designed to promote transformative improvement within the clinical learning environments
   • 8 awardees
Outline

1. Background and Motivation
2. Project Setting
3. Analysis and Redesign of Graduate Medical Education (GME)
   a. Broader long-term project
   b. Phase 1 objectives
   c. Tools and methods
4. Summary and Future Work
5. How to Get Involved
**Mission**: Broad measureable impact on healthcare, nationally, through research, education, and application of industrial and systems engineering.
ACGME CLER Innovation Project

- ACGME “Pursuing Excellence in Clinical Learning Environments”
- Clinical Learning Environment Review, 3 year national study
- 8 awardees, 5 year project
- Multidisciplinary skill mix
- Innovation, collaborative learning, national spread
- “8 to 80 to 800” (AMCs)

‘Imagine the systemic impact of all graduates across all health professions trained & experienced in quality improvement and safety science.’

Key findings - Huge variation:
1. How conduct GME and align with org’s goals & support
2. Resident training in safety & quality
3. Faculty development
4. Inter-professional training
Motivation

• Healthcare changed dramatically over last few decades, but GME undergone little redesign:
  – Care teams versus silos
  – Communication and coordination
  – Team-based quality & safety
  – etc

• Poor wellness among medical students, residents, physicians:
  – Burnout, depression, retention, satisfaction, etc
Overall CLER Innovation Collaboration

**AIM**
Integrate health care operations and graduate medical education such that the clinical learning environment enables measurable improvement in both learner experience and patient care.

**Primary Drivers**

- Create a shared infrastructure that aligns with organization’s strategic priorities and GME strategy.
- Establish the processes & practices that fully integrate CLE staff and learners into the pursuit of quality, safety, equity and value in the organization.
- Create qualified, engaged and motivated faculty capable of teaching quality and safety to residents.
- Maximize interdisciplinary learning with coordinated educational resources across health professions.

**Local Designs**

- Local innovation and design ideas and projects
- Process, structure, and outcome measures
MMC/HSyE Project

• Inter-professional care teams

• Inter-professional education in teams (duh)

• E.g. one rounds, one med rec, one discharge, on note

• ‘Learning lab’ physical environment - prototype, simulation, testing place

• Spread/replicate test across health system
Aim 1: Define and analyze current GME processes from a systems engineering perspective
Wellness/Burnout Design Spec.

• Design spec:
  - All redesigns must add no additional burden
  - Ideally remove burden

• Design methods

• Measure this value

• Business, sustainable, spread case requisite
Physician Burnout

- 6,880 physician survey (2014)
- 54% reported ≥ 1 burnout symptom
- 45% in 2011
- Work-life balance satisfaction 49% (2011), 41% (2014)
- Non-healthcare 28% with negligible change

Depression and Suicide

- Physicians and medical students have high rates of depression
- Systematic review and meta-analysis:
- Medical students have a 27% prevalence of depression and 11% prevalence of suicidal ideation

Phase 1 Tools and Methods

Objectives:
1. Process logic
2. Work as imagined versus work as done
3. Broader work/ergonomic context
4. Statistical performance
5. Types and causes of failures (& successes)
6. Interdependencies

Methods:
- Interviews and Observations
- Cross-Functional Process Maps
- Time Studies and Work Breakdown
- Macro-Ergonomic Framework
- Functional Interdependencies
1. Interviews and Observations

- Conducted semi-structured one-on-one and group interviews
- Shadowed care team members between hours of 7am-6pm
- Used results to inform other analysis methods

<table>
<thead>
<tr>
<th>Profession</th>
<th>Interviews</th>
<th>Observations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resident</td>
<td>13</td>
<td>9</td>
</tr>
<tr>
<td>High level management</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>Nurse</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Attending</td>
<td>9</td>
<td>0</td>
</tr>
<tr>
<td>Care manager</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Patients</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
2. Cross Functional Process Flow Maps
(‘swim lane diagrams’)  

- Basic systems engineering and improvement tool
- Understand work flows through a system over time
- Identify potential bottlenecks, failures, and delays
3. Time Studies / Work Breakdown

- Analyze how residents spend time and variation that exists between residents and between days
- Study real-life work patterns compared to process map
4. Macro-Ergonomic Work Context
(SEIPS: Systems Engineering Initiative for Patient Safety)

• Systems framework for understanding processes, structures, inter-relationships, and outcomes
• Useful for brainstorming potential failure and redesign areas
5. Functional Interdependencies
(FRAM: Functional resonance analysis method)

- Focuses on key functions ("to xyz" verbs)
- Identifies interdependencies & potential failure points
- Systems science tool from ‘safety-2 complexity’ field

6. Failure Analysis  
(FMEA: Failure Mode Effects Analysis)

- Reliability engineering redesign tool
- Identify potential failure types (modes) & mitigation strategies
- Prioritize by severity, frequency, & consequence preventability

<table>
<thead>
<tr>
<th>Process Step</th>
<th>Failure Mode</th>
<th>Effect</th>
<th>Severity</th>
<th>Cause</th>
<th>Probability</th>
<th>Controls</th>
<th>Detection</th>
<th>Criticality</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Sign-Out</td>
<td>Information across interdisciplinary care team is inconsistent</td>
<td>Patient doesn’t receive appropriate care/treatment (patient safety)</td>
<td>10</td>
<td>Not everyone is present during hand-off (e.g. nurses)</td>
<td>10</td>
<td>None</td>
<td>10</td>
<td>100</td>
<td>Communication</td>
</tr>
<tr>
<td></td>
<td>Interruptions (cause across the board)</td>
<td></td>
<td>10</td>
<td>None</td>
<td>10</td>
<td>100</td>
<td>Communication</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Pre-Rounds</td>
<td>Insufficient or inaccurate patient communication to providers</td>
<td>Patient doesn’t receive appropriate care/treatment (patient safety)</td>
<td>10</td>
<td>Family members, translators not available</td>
<td>7</td>
<td>None</td>
<td>10</td>
<td>70</td>
<td>Communication</td>
</tr>
<tr>
<td>3</td>
<td>Incomplete/inconsistent communication about plan with patient and other providers, patient dissatisfaction</td>
<td>Data not available, labs not back yet</td>
<td>9</td>
<td>Whiteboard - describes the plan and when they are going home (not updated till rounds) Pre pre-round huddle (most days but varies on how it occurs and with whom, informal not documented)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Communication</td>
</tr>
<tr>
<td>4 Daily Rounds</td>
<td>Inefficient use of time per patient presentation</td>
<td>Creates lengthy rounds (less time for patient care post rounds)</td>
<td>5</td>
<td>Time management (balancing learning and care)</td>
<td>10</td>
<td>Suggested limit of 90 mins</td>
<td>7</td>
<td>50</td>
<td>Schedule/Logistics</td>
</tr>
<tr>
<td>5</td>
<td>Part of the care team is not present</td>
<td>Patient care (Patient information not relayed to entire team)</td>
<td>10</td>
<td>General interruptions (unnecessary/necessary pages)</td>
<td>6</td>
<td>None</td>
<td>10</td>
<td>60</td>
<td>Interruptions</td>
</tr>
<tr>
<td>6 Computer-Based Care</td>
<td>Notes incomplete</td>
<td>Patient care (Other providers may misunderstand partial notes)</td>
<td>10</td>
<td>Interruptions (notes get filled in when ever possible)</td>
<td>10</td>
<td>Policy: All notes should be completed within the workday</td>
<td>7</td>
<td>100</td>
<td>Schedule/Logistics</td>
</tr>
</tbody>
</table>
Summary / Assessment

• Collectively these tools assisted in identifying current barriers/successes in GME processes:
  – Strains on time and work burden
  – Interruptions and fragmentation in work flows
  – Lack of communication
  – Scheduling and logistical barriers

• Systems engineering methods valuable addition to GME improvement efforts

• Generalizable approaches (?)
Future Work

• Conduct analyses from different perspectives
  – Nurse, Patient, Burnout

• Conduct detailed analysis on care team interruptions and communication gaps

• Analyze GME from a longitudinal (3-year) framework

• Develop toolkit for dissemination and spread to other academic medical centers
Interested in help or helping?

Please help replicate this work in your system. Create visibility for IE on national initiative

HSyE coaching available
Tools, templates, report, webinar

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