Objective

- **Overall:** Redesign interprofessional clinical learning environments to improve (1) care quality, (2) learning outcomes, and (3) provider well-being & satisfaction
- **Project Specific:** Analyze current state of graduate medical education (GME) in an internal medicine residency program from a systems engineering perspective

Study Settings

- Pilot setting: Maine Medical Center (Portland, ME)
  - Largest medical center in Maine, 637 beds
  - Only medical school in the state (associated with Tufts)
  - Internal medicine residency program (47 residents, 225 attendings)
- Four secondary settings to replicate results
- Healthcare Systems Engineering Institute (Boston, MA)
  - Expertise in design and analysis of complex systems of systems
  - 5 federally-awarded centers applying systems engineering methods

Background & Motivation

- Healthcare has changed dramatically, but GME remains much the same
- Physicians and medical students suffer high rates of depression and burnout
  - Medical students: 27% depression prevalence, 11% suicidal ideation [1]
- Over 54% physicians experience ≥1 burnout symptom in 2014 [2]
- Accreditation Council for Graduate Medical Education (ACGME) national study
- Significant variation in resident training across United States
- Funding 8 academic medical centers to develop innovative, collaborative solutions that can be spread nationally

Interviews & Observations

- Conduct semi-structured 1-on-1 and group interviews
- Shadow care team members (residents, nurse, care manager)

Cross Functional Process Flow Maps

- Understand stakeholder workflows over time
- Potential bottlenecks, failures, and delays
- Use as basis for other analyses

Time Studies

- Analyze how residents spend time and variation between residents and days
- Study actual work patterns ("work-as-done") vs. process flow maps ("work-as-imagined")

Macro-Ergonomic Work Context

- Systems Engineering Initiative for Patient Safety (SEIPS): framework for understanding processes, structures, inter-relationships, and outcomes
- Study larger work context (enablers and barriers) within which GME occurs

Failure Analysis

- Conduct Failure Mode Effects Analysis (FMEA), a reliability engineering design tool
- Identify and prioritize potential failures by severity, frequency, and consequence
- Conduct Failure Mode Effects Analysis (FMEA), a reliability engineering design tool

Functional Interdependences

- Use Functional Resonance Analysis Method (FRAM), a systems science tool from the "Safety-II complexity" field, to identify interdependences among key functions

Results

- Identified barriers and challenges in interprofessional education:
  - Work burden and strains on time
  - Interruptions and fragmentation in work flows (left)
  - Lack of communication between disciplines (below)
  - Scheduling and logistical barriers

Conclusions and Future Work

- Systems engineering tools are valuable for evaluating and redesigning GME
- ACGME “8 to 800” initiative: We are seeking other medical centers to help
  - Evaluate the utility of these methods for improving GME programs
- Contact m.jacobsen@northeastern.edu to get involved