Team H.O.P.E.
Hospital Optimal Productivity Enterprise

Jonathan Anderson, Daniel Kalowitz, Jay Kellegrew, Katie Johnson, Ben Kubic, Joseph Lim, Julie Markowitz, John Silberholz, Alex Simpson, Emily Sze, Ekta Taneja, Eddie Tao, Esther Yang

Mentor: Dr. Bruce Golden
Introduction

- Health care is a major concern
  - Americans spent $1.7 trillion on health care in 2003
- Hospitals one of the least efficient sectors
- Team HOPE
  - Model emergency department (ED) at the University of Maryland Medical Center (UMMC)
  - Run simulations to find methods of improving patient throughput
Small Projects

- Emergency Department Analysis
- TeleTracking System
- Discharge Lounges
- Intrahospital Transportation
Research Questions

- How can ED efficiency and patient throughput be increased?
- What quantifiable factors are most effective in improving ED efficiency?
- What data will we need to create our model?
- What resources should we focus on in terms of management and operations in the ED?
UMMC ED – Statistics Snapshot

- 34 ED beds
- Daily, ~3.6 patients pass through one bed
- Annually, 400-plus ambulance diversions
- Overall ED Length-of-Stay: 6 hours
  - ED Length-of-Stay for admitted patients: 10.3 hours
  - ED Length-of-Stay for patients treated in and discharged from the ED: 9.7 hours
- Overall, 15% of patients leave without being seen
ED Priority Numbers

- Scale of 1-4, with 1 being top priority (urgent, life-threatening) and 4 being lowest priority (patient came in to fill a prescription)

- Triage nurse determines by:
  - Chief complaint
  - Signs and symptoms
  - Past medical history
  - Urgency of vital signs
  - Personal instinct

- If available, priority 1 patients receive a bed immediately

- Generally, priority 2 and 3 are routed back to the waiting room
Patient Flow in the UMMC ED

University of Maryland Medical Center
Emergency Department
Baltimore, MD

URGENT CARE
aged 18 or younger

ISOLATION BEDS

PEDIATRICS

ISOLATION BEDS

CENTRAL ED HUB

ED Waiting Room

P2, P3

ED Public Front Door

Walk-In Patient FastReg

TRIAGE ROOMS

EKG Consult Room

Ambulance Entrance

BEDS

URGENT CARE
Waiting Room

P4

BEDS

RADIOLOGY

SAFETY ROOMS

SAFETY ROOMS

BEDS

RDU
(4)

P1

BEDS
(34)
The Teaching System at UMMC

- "Teaching hospital"
- A single patient is seen by:
  - Third-year medical student
  - Intern
  - Resident
  - Attending doctor
- Each must perform their own initial assessments and report back to their supervisor
- Only the attending doctor may assign the disposition of the patient
- Redundancy = Bottleneck
Also used simulation to model an ED to improve throughput

However, very different type of hospital

- Less than half the beds (200 vs. 670)
- Regional, rural hospital
- Adults and children treated by same ED
- No teaching process in place
- No ability to turn away patients

Methodologies will still be similar

Ruohonen, 2007
Hospitals can use computer simulation to improve hospital efficiency.

We will create a computer model to simulate how the UMMC ED operates.

This model will help us discover and eliminate bottlenecks.

Steps we will take to create a computer model (see diagram to the right):

- Problem definition
- Process analysis and the building of a conceptual model
- Is the conceptual model valid?
- Yes
  - Modeling phase
  - Is the developed computer model valid?
  - Yes
    - Simulation phase
    - Documentation of the results
- No
  - Modeling phase

Ruohonen, 2007
Patient Flow and Historical Data

- Patient flow data
  - Observe patient flow
  - Interview ED personnel

- Historical Data
  - Proportion of patients with each condition
  - Attributes of conditions – probability in need of testing and further hospitalization, average length of stay
  - Data spans time of day, day of week, week of year
  - Collected from hospital databases
Group-Collected Data

- Not all data in databases
- The remaining data needed must be collected manually
  - Using a common form for data collection
  - Observing ED and collecting data
- Much timing data must be collected
  - Time spent in specific locations
  - Time spent doing specific procedures
  - Specific information about triage levels
  - Specific information about different types of health professionals
Simulation Model Creation

- Acquire simulation software (likely Arena)
- Define metric (likely patient throughput)
- Develop conceptual model
- Develop actual model
- Determine external validity of metric for whole system and subsystem
  - Compare system-wide wait times with historical values
  - Check if results are reasonable with ED personnel
Experimental Design

- Use initial model to determine bottlenecks
- Develop solutions
  - Based on simulation model
  - Based on observations/intuition
  - Based on interviews with hospital personnel
  - Based on literature review
- Test solutions, compare to model of current operations as baseline
- Use ANOVA to determine significance of improvements
Problems

- Assumptions
  - Medical technology, patient patterns similar from year to year
  - Database data is reasonably accurate

- Confounding variables
  - Protocol changes
  - Data omissions and errors

- Limitations
  - Only access to UMMC data
  - No custom queries
  - Teaching hospital
Overcrowding is preventing hospitals from running at full capacity.

HOPE plans to improve efficiency through:
- Hospital records and first-hand observations
- Identifying bottlenecks
- Formulating models and simulation

Through simulation, HOPE plans to save UMMC money and increase patient satisfaction.
<table>
<thead>
<tr>
<th>Task Name</th>
<th>Duration</th>
<th>Start</th>
<th>Finish</th>
<th>Predecessors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect data from UMMC for simulation</td>
<td>80 days</td>
<td>Mon 9/1/08</td>
<td>Fri 12/19/08</td>
<td></td>
</tr>
<tr>
<td>Begin programming existing UMMC ED patient flow model</td>
<td>80 days</td>
<td>Mon 9/1/08</td>
<td>Fri 12/19/08</td>
<td></td>
</tr>
<tr>
<td>Establish possible improvements to ED patient flow</td>
<td>85 days</td>
<td>Mon 1/26/09</td>
<td>Fri 5/22/09</td>
<td>2</td>
</tr>
<tr>
<td>Test effectiveness of changes in model</td>
<td>85 days</td>
<td>Mon 1/26/09</td>
<td>Fri 5/22/09</td>
<td></td>
</tr>
<tr>
<td>Continue creating models with possible changes</td>
<td>85 days</td>
<td>Mon 1/26/09</td>
<td>Fri 5/22/09</td>
<td></td>
</tr>
<tr>
<td>Present a research poster at Undergraduate Research Day</td>
<td>85 days</td>
<td>Mon 1/26/09</td>
<td>Fri 5/22/09</td>
<td></td>
</tr>
<tr>
<td>Gather information from simulations and analyze effectiveness of all changes</td>
<td>90 days</td>
<td>Mon 8/31/09</td>
<td>Fri 12/18/09</td>
<td>6</td>
</tr>
<tr>
<td>Begin drawing conclusions from data analysis</td>
<td>80 days</td>
<td>Mon 8/31/09</td>
<td>Fri 12/18/09</td>
<td></td>
</tr>
<tr>
<td>Start writing team thesis</td>
<td>80 days</td>
<td>Mon 8/31/09</td>
<td>Fri 12/18/09</td>
<td></td>
</tr>
<tr>
<td>Attend Gemstone senior orientation</td>
<td>80 days</td>
<td>Mon 8/31/09</td>
<td>Fri 12/18/09</td>
<td></td>
</tr>
<tr>
<td>Continue writing team thesis</td>
<td>80 days</td>
<td>Mon 8/31/09</td>
<td>Fri 12/18/09</td>
<td></td>
</tr>
<tr>
<td>Present and defend thesis to Gemstone staff and experts</td>
<td>80 days</td>
<td>Mon 1/25/10</td>
<td>Fri 5/14/10</td>
<td>9</td>
</tr>
<tr>
<td>Make any necessary changes to thesis and present final work to UMMC</td>
<td>80 days</td>
<td>Mon 1/25/10</td>
<td>Fri 5/14/10</td>
<td></td>
</tr>
<tr>
<td>Present finalized results to UMMC</td>
<td>80 days</td>
<td>Mon 1/25/10</td>
<td>Fri 5/14/10</td>
<td></td>
</tr>
<tr>
<td>Graduate</td>
<td>80 days</td>
<td>Mon 1/25/10</td>
<td>Fri 5/14/10</td>
<td></td>
</tr>
</tbody>
</table>
Contacts

Mary Nelson
Emergency Department Director of Nurses
mnelson@umm.edu

Derryl Johnson
Emergency Department Financial Officer
dejohnson@umm.edu

Kevin M. Reynolds
Patient Transportation Manager
kreynolds@umm.edu

Mike Harrington
Director, Patient Access
mharrington@umm.edu
The End
Any Questions?