Improving Endoscopy Ward Process Flow with Simulation

Central Arkansas Veterans Hospital System (CAVHS) in Little Rock, AR

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Introduction

The Central Arkansas Veterans Healthcare Service (CAVHS) is a veterans' hospital in Little Rock, Arkansas. It strives to honor America's Veterans by providing them with quality healthcare. Our team worked within the endoscopy ward at the hospital where the staff and patient families were complaining about how the process flow was inefficient and waiting times were long. Our team was requested to analyze the current system and provide alternative courses of action to improve the resource utilization, patient throughput, and process time, and improve the waiting experience for families, all while maintaining the quality of care the hospital is known to provide their patients.

Purpose/Requirements

The purpose of this Capstone project was to improve the current state of the endoscopy ward while taking into account key objectives. The stakeholders, objectives, and key measures are color-coded purple, blue, and green, respectively. These objectives were assigned as follows and can be shown in Figure 1:

- Improve the process flow in the endoscopy ward
- Increase patient throughput
- Improve resource utilization
- Improve the experience for the patients' families in the waiting room area
- Maintain the quality of care provided to patients and families

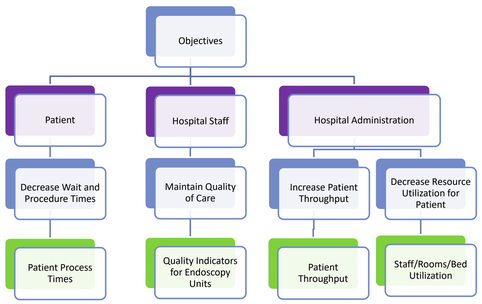


Figure 1. Objectives for each key stakeholder

We created a decision model to represent the key issues, constraints, and desired results (Figure 2) upon recognizing courses of action to focus on.

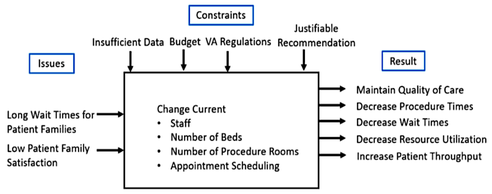
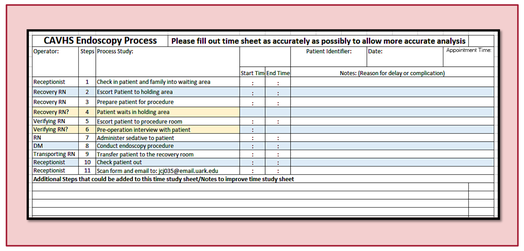


Figure 2. Decision Model

Methodology

Data Collection & Analysis

The first part of our project involved breaking down the current process into steps. We created a timesheet to conduct a time study on the current endoscopy and colonoscopy process. We focused on identifying the start and end times for each step in the process along with appointment and arrival times of the patient.



CAVHS Endoscopy Process — Please fill out time sheet as accurately as possibly to allow more accurate analysis

Operator:	Steps	Process Study:	Start Time	End Time	Patient Identifier:	Date:	Appointment Time
					Notes: (Reason for delay or complication)		
Receptionist	1	Check in patient and family into waiting area	:	:			
Recovery RN	2	Escort Patient to holding area	:	:			
Recovery RN	3	Prepare patient for procedure	:	:			
Recovery RN?	4	Patient waits in holding area					
Verifying RN	5	Escort patient to procedure room	:	:			
Verifying RN?	6	Pre-operation interview with patient	:				
RN	7	Administer sedative to patient	:	:			
GM	8	Conduct endoscopy procedure	:	:			
Transporting RN	9	Transfer patient to the recovery room	:	:			
Receptionist	10	Check patient out	:	:			
Receptionist	11	Scan form and email to: jcj035@email.uark.edu	:	:			

Additional Steps that could be added to this time study sheet/Notes to improve time study sheet

Figure 3. Timesheet used for data collection

Using the data collected from the time study, we created Pareto Charts as seen in Figure 4. We found that the times spent in the holding room (step 4), recovery room (step 10), and the waiting room (step 1) were taking up the most amount of time in the process. Step 10 is subjective to each patient's need for recovery and, therefore, cannot be controlled. We concluded step 4 and 1 to be the non-value-added time in the process that we can control or change.

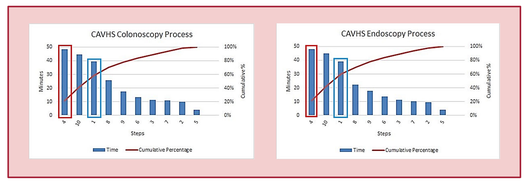


Figure 4. Pareto Charts for Colonoscopy and Endoscopy processes

A discovery our team made after collecting the data was how the endoscopy ward was scheduling its patients' appointments. Figure 5 shows the average number of patients scheduled for different appointment times throughout the day. The ward would schedule multiple patients within thirty minute intervals of one another while the endoscopy and colonoscopy would take an average of two hours and thirty minutes from patient entry to departure.

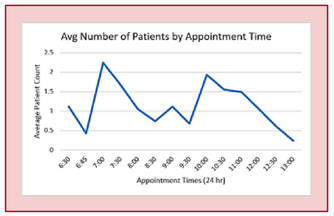


Figure 5. Average Number of Patients by Appointment Time

The box plots in Figure 6 show the overall process times for by appointment time throughout an average day. This shows the endoscopy process time peaks during the day for total process time. We analyzed scheduling before these peak times, starting with 7 AM. The colonoscopy process time shows high variability in process times at 10 AM, 11 AM, and 12 PM, showing inconsistency.

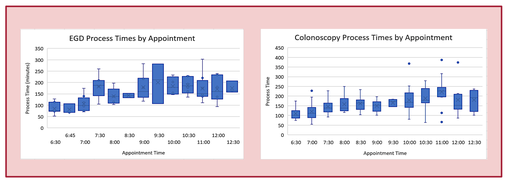


Figure 6. Endoscopy and Colonoscopy Process Times by Appt. Time

Simulation

The Industrial Engineering tool we chose to use to model the current process of patient flow through the endoscopy ward was Arena, a discrete event simulation software. The input resource variables were: number of staff members (doctors, registered nurses), number of procedure rooms, and number of available recovery beds. We also input appointment and break scheduling based off of conclusions we had made from our data analysis.

We output patient wait times, procedure times, resource utilization, and throughput of patients. These outputs and their performance measures were analyzed to give suggestions to our industry partner. These suggestions will be to modify the decision variables of the current number of doctors, nurses, procedure rooms, and recovery beds available, as well as patient arrival times for scheduling appointments.

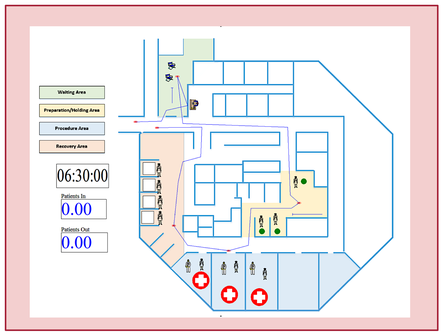


Figure 7. View of the Animation of the Ward from the Simulation

Results

In comparison to our baseline simulation:

- **Alternative 1:** Adding extra doctor, 2 nurses and procedure room for a morning shift
  - This alternative caused a decrease in colonoscopy and endoscopy process times by 11% and 9% respectively. It also reduced the time the patient is waiting in the holding room and waiting room by 36% and 35% respectively.
- **Alternative 2:** Remove peak time patient arrivals
  - Removing peak times, like 7am and 11am, caused a decrease in colonoscopy and endoscopy times by 4% and 2% respectively. It also reduced the time the patient is waiting in the holding room and waiting room by 5% and 30% respectively.
- **Alternative 3:** Change patient arrival schedule times to 15 minute intervals.
  - This alternative decreased the colonoscopy and endoscopy times by 18% and 13% respectively. It also reduced the time the patient is waiting in the holding room and waiting room by 41% and 85% respectively.

Conclusions

Using a combination of our data analysis and our simulation, we were able to conclude that the CAVHS should change the scheduling of patients to come in every 15 minutes, excluding times when doctors and nurses are going on breaks, to allow waiting times in the waiting room to reduce significantly causing a decrease in overall process times.

Future Work

Since this project was so open-ended, we were unable to solve all the problems given to us by the hospital. Future groups who work with the CAVHS would likely work towards improving the communication system currently in place at the hospital, along with improving the state of the waiting room to make waiting more bearable for the patients' families.

Acknowledgements

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