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USING SIMULATION IN THE ARCHITECTURAL CONCEPT PHASE OF AN EMERGENCY DEPARTMENT DESIGN

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ABSTRACT

This paper describes an emergency care center simulation (ECC) project at Sarasota Memorial Hospital in Sarasota, Florida. The objective was to project bed requirements for an emergency care center expansion. The project team also analyzed the impact on downstream departments that are an integral part of the ECC. The simulation model was developed at a macro level and targeted the capacity requirements based on length of stay for each of the patient areas affected by the expansion. This macro-level model, used for the architectural concept phase, was designed to allow for enhancement into a micro-level model to analyze the detailed processes of the ECC once the basic concepts of layout, number of rooms and beds, and hours of operations were established.

1 INTRODUCTION

Sarasota Hospital is an 845-bed regional medical center and the second largest public hospital in Florida. It is in the Top 25 in the US for the number of open-heart surgeries and in the Top 10 for the number of joint replacements performed. It was the first non-academic hospital in the nation to conduct clinical research. The existing ECC structure opened in 1993 with a 43,000 annual visit capacity. At that time it was projected that managed care would reduce utilization, but in contrast, visits have been growing. An increasing and aging population and local changes in emergency services contributed to an increasing number of visits – almost 80,000 in 2002.

A project team was established to drive planning for the new ECC. The team consisted of the architectural firm, hospital management, physicians, management consultants, and user group design teams. The design teams were made up of staff from each treatment modality.

2 SYSTEM DESCRIPTION

The facility consists of two separate emergent care systems – the ECC and the UCC. The UCC contains a single pod of beds and has a dedicated X-ray suite. The ECC is made up of three pods of beds. Admissions are performed either in the bed or in the Meckler Admissions Center. Discharges are performed in the bed or in Discharge Services. Figure 1 depicts the patient flow between elements of the ECC and Figure 2 identifies the entry and exit points for patients.

The following definitions were used in this study:

- Acute Emergency Patients – Critically ill or injured patients.
- Clinical Decision Unit/Chest Pain Center (CDU) – Beds for observation and chest pain patients.
- Direct Admits – Patients admitted to the Hospital directly from the Physician's Office.
- Discharge Services (DCS) – Chairs and beds for patients discharged from Inpatient Units.
- Emergency Care Center (ECC) – Three pods of acute emergency care beds.
- Length of Stay (LOS) – The total time a patient spends in the ECC system.
- Meckler Admission Center (MAC) – Beds for direct admit patients from the physicians office.
- Minor Emergency Patients – Minor illness or injury.
- Observation Patient – Patients needing extensive testing and observation to determine status and inpatient criteria.
- Special Emergency Care Unit (SECU) – Beds for patients with psychiatric needs or Baker Act Patients.
- Urgent Care Center (UCC) – Beds for minor emergency Patients.

3 ASSUMPTIONS

The following assumptions were included in the model development and planning process:

- 5% annual visit increase.
- 1.6% increase in the over 45 age category.
- LOS based on current length of stay and operational efficiencies.

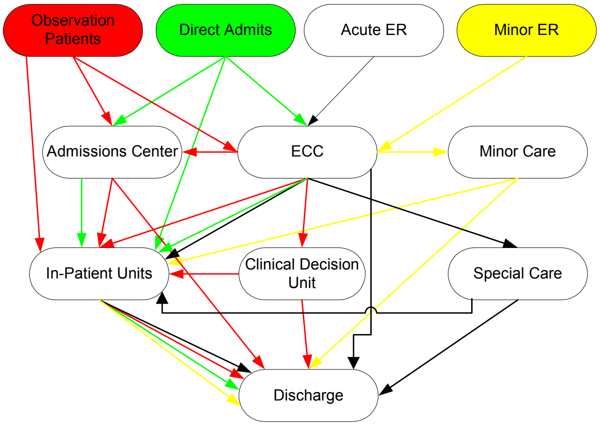

Figure 1: Patient Flow

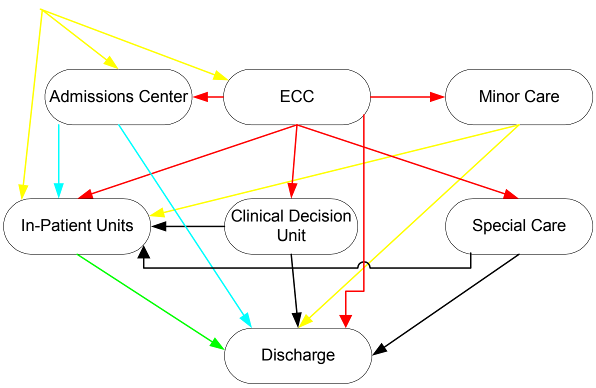

Figure 2: Entry/Exit Points

- Pod A is always open.
- Patients finish out their treatment even after location closes.
- Ambulance and walk-in patients are treated the same.
- UCC X-Ray patients have tests performed in the UCC X-Ray room.
- UCC and SECU patients are not admitted.
- Psychiatric patients have priority for SECU rooms.
- SECU patients are those in the SECU as well as those in ECC rooms that have illness codes like Psychosis, Alcohol Intoxia & Depression.
- Psychiatric patients take regular beds if SECU rooms are occupied.
- SECU patients that are overflow from the 2 SECU rooms are not placed in Pod C.
- If a psych patient is in one of the SECU beds, regular ECC patients will not be placed in the other bed.
- Patients keep their room or location when going for tests.
- Patients are either discharged or admitted. Transfer, Against Medical Advice, Left Without Being Seen By Physician, Expired & DOA are treated as discharge patients.
- Admit time is the same in ECC and MAC.
- Discharge time is the same for Discharge Services and ECC.
- If Discharge Services is full, patient is discharged from their room.
- If MAC is full, patient is admitted from their room.
- X-ray occurs 1/2 way through treatment time (used to output x-ray frequency).
- Portable x-rays are not included.
- Radiology, CT and Sonogram are open 24/7.
- The factor applied to treatment times to adjust for age differences is the same for ECC, UCC, SECU.

4 PROCESSES

Figures 3 through 6 depict the macro-level process flow for the ECC. Individual process steps within a treatment room

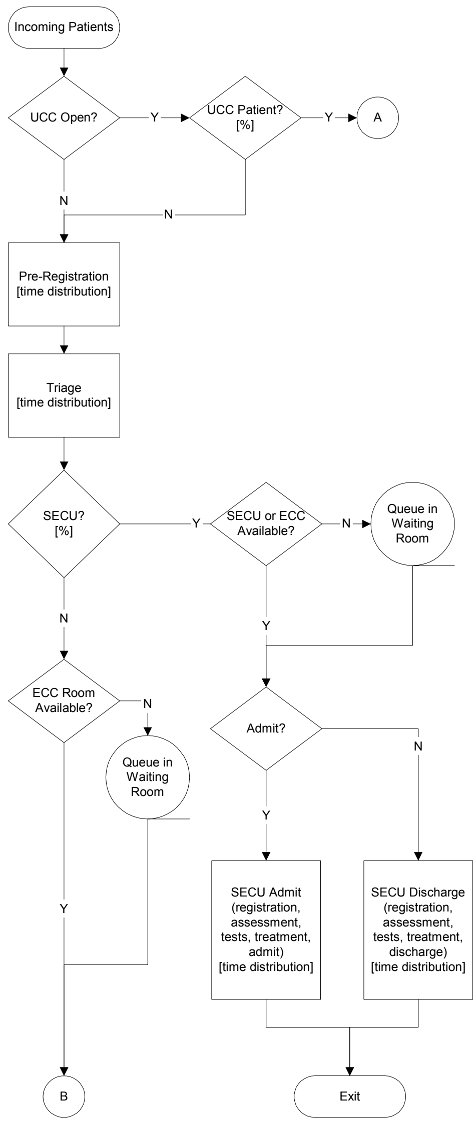

Figure 3: ECC Process (1 of 4)

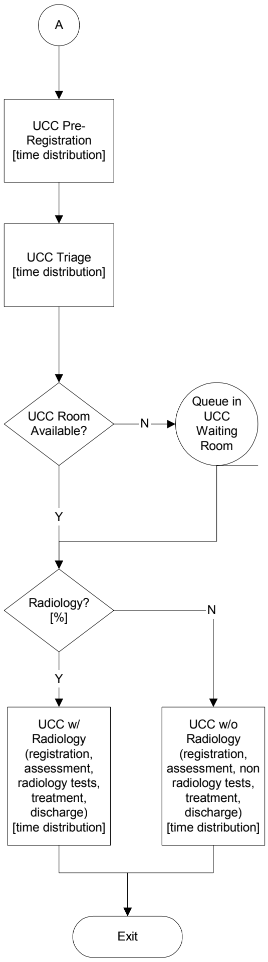

Figure 4: ECC Process (2 of 4)

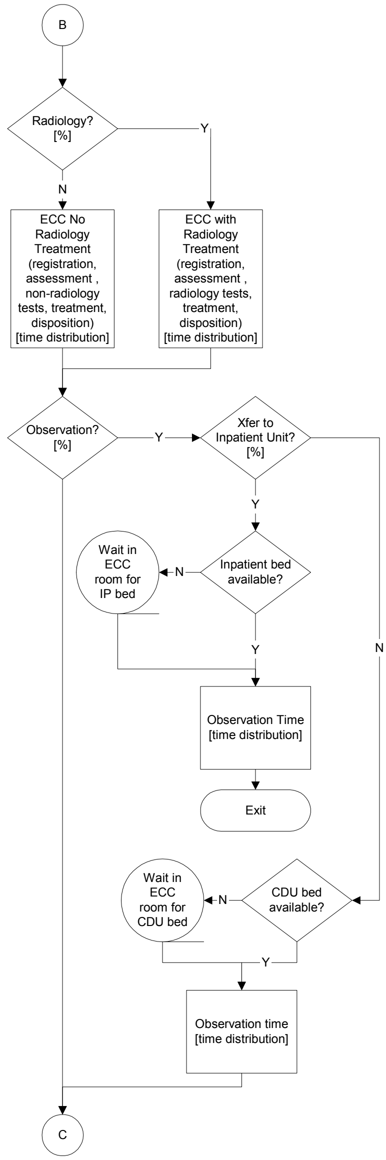

Figure 5: ECC Process (3 of 4)

are not defined or modeled. Instead, each distinct location in the process is defined. This level of detail is appropriate for the concept phase. Once the number of locations and layout are defined, a detailed model can be developed to assess the performance of detail-level changes to the process.

5 MODEL FEATURES

The model was constructed with several features designed to ensure the usability of the simulation. First, a custom spreadsheet user interface was constructed to allow easy data entry and display of results (Figure 7). Not only is the running of the simulation scenarios transparent to the user, but with certain simulation applications the model can be run with a no or low cost run-time license or viewer program.

One characteristic of interest to the team members was the effect on the model of the aging population. Data was captured from the hospital on-line system to calculate the patient age and length of stay. Figure 7 show the age profile of patients and Figure 8 shows the length of stay by age. This data was then incorporated into the model – a patient age distribution was applied to incoming patients and a subsequent length of stay multiplier, based on the actual length of stay data, was applied. The model therefore applied a longer length of stay to older patient.

6 SCENARIOS

Five key scenarios were run once the baseline model was verified and validated:

- Projected ECC patient volume increase
- Observation patients location and volume
- Hours of operation for pod closure
- Radiology room requirements (X-ray, CT, US)
- MAC and DCS projected volumes

In addition, the model was used to analyze the impact of increased aging of the population on LOS and bed capacity.

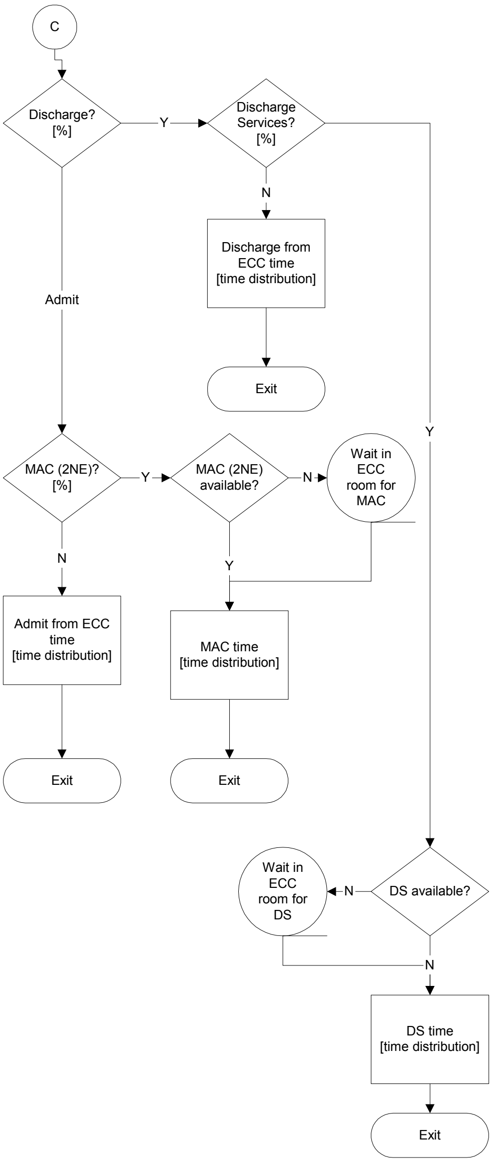

Figure 6: ECC Process (4 of 4)

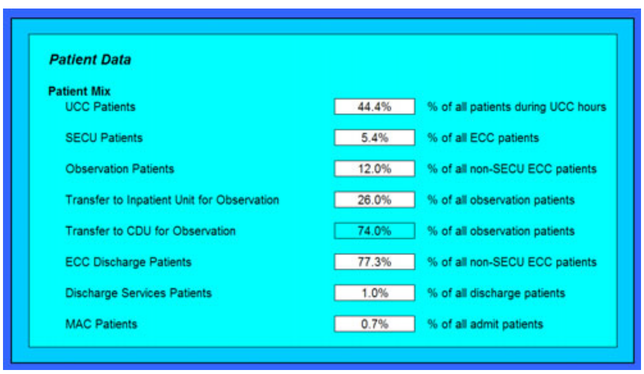

Figure 7: User Interface

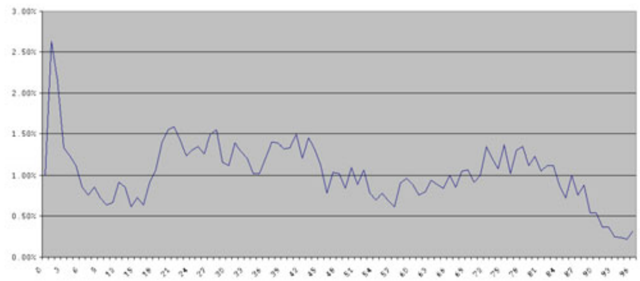

Figure 8: Patient Age Profile

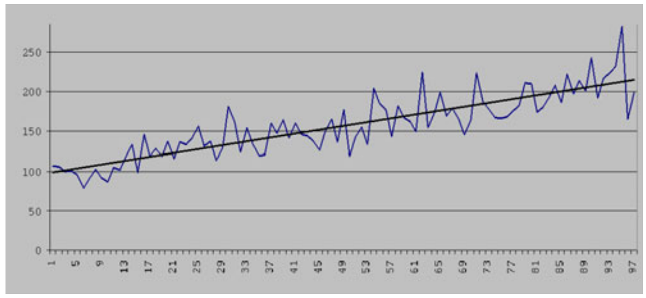

Figure 9: Patient Average LOS By Age

7 RESULTS

Table 1 lists the recommendations resulting from scenario data analysis. By comparing metrics such as average length of stay, average time in queue and maximum number in queue, the optimal number of beds and hours of operation were determined. Figure 10, the hourly census for the UCC waiting room, is an example of one of the many graphs that were automatically generated by the user interface. Figure 11 shows the average census for the same location, but displayed by day of week.

Table 1: Simulation Recommendations

Location	Beds	Hours
Pod A	24	24/7
Pod B	8	7a-11p
Pod C	12	9a-11p
SECU	6	24/7
UCC	18	9a-11p
CDU	21	24/7
Total	89	

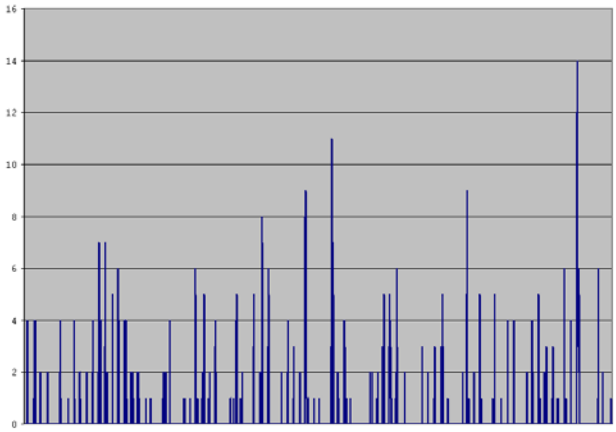

Figure 10: UCC Waiting Room Census

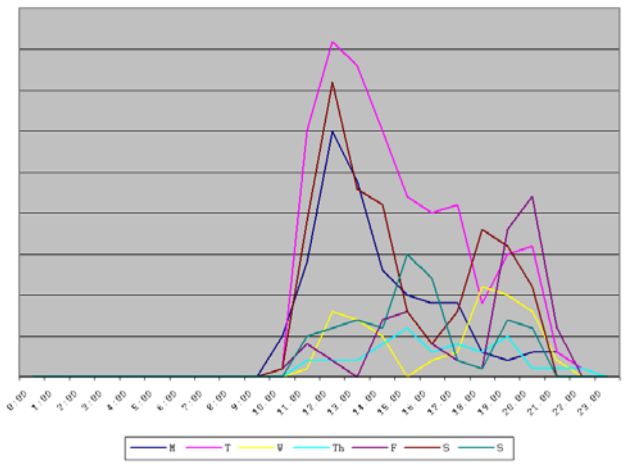

Figure 11: UCC Waiting Room Census Weekly Pattern

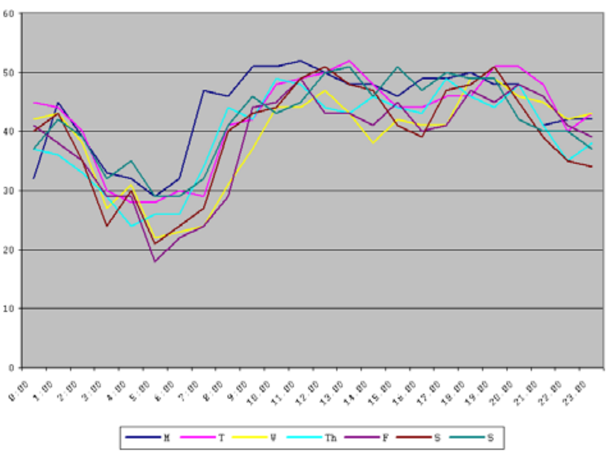

Figure 12: ECC X-Ray Census Weekly Pattern

8 CONCLUSION

The simulation model was used to predict future capacity requirements for the ECC and provided a check and balance for figures determined by other analysis methods. As a result of the model project, several previously unaddressed areas were identified, including the necessity of increasing space allocated to the X-ray department to account for two additional X-ray machines needed to handle future patient load, the need for an additional triage station and the need for less acute care beds than originally projected. As a result, the simulation provided significant benefits in terms of projected financial savings and operational improvements.

Since the hospital may continue to build on this model as well as engage in other simulation projects, the custom user interface proved to be a valuable feature allowing easy running of scenarios.

The team also identified several potential follow-on uses for the baseline model. One was to expand the scope of the model to assess the process at a greater level of detail (e.g., patient and staff travel and flow). Other opportunities including considering the impact of patient and market factors such as:

- Patient age
- Patient needs (e.g., psychiatric patients)
- Observation patient treatment trends

AUTHOR BIOGRAPHIES

ALLAN WIINAMAKI has been a Senior Management Consultant with Sarasota Memorial Hospital, Sarasota Florida for six years, including a period as Interim Director of Management Support Services. He has 15 years of experience in Healthcare Systems Improvement. He holds a Bachelor of Science in Engineering Management from Oral Roberts University. He is also a Senior Member of the Healthcare Information and Management Systems Society. He has been an active 15-year member of the national association as well as a leader and presenter at the local association level. He can be contacted by e-mail at <mailto:allan-wiinamaki@smh.com>.

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