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HOSPITAL NETWORK PATIENT TRANSPORT PLANNING USING INTERACTIVE ON-THE-FLY SIMULATION

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ABSTRACT

Simulation models have been used in logistics to evaluate transportation of goods throughout a region, zone or country. When it comes to transporting patients between facilities in the healthcare industry, most simulation models center around activities at the origin facility or destination facility with the goal of refining hospital operations to prepare a patient for transfer or the in-take of arriving patients. Few models focus on the network of ambulances needed to complete these inter-facility transfers. This case study presents a method for evaluating dispatch locations within a geographically wide-spread network servicing a mix of rural and metropolitan areas. Furthermore, the simulation model takes into consideration the location of the facilities, the routes of travel between locations, and how external factors, such as weather conditions, might impact efficiency.

1 INTRODUCTION AND PROJECT GOALS

This transportation simulation was conducted for a network that included three hospitals, with transfers to and from over forty hospitals and treatment centers across three states in the continental United States. The transportation of patients was completed from six dispatch locations spaced throughout the region, with the option of adding up to two additional locations based on need. Each dispatch location could support up to two rigs. Patient transfer requests consisted of origin facility, destination facility and request time.

In the simulation model, rigs (ambulances) were dispatched from their home location to the origin facility based on the transfer request time. Rigs would travel over roads and highways overlaid on a map of the region. Travel speeds were variable based on road type and user defined weather conditions. Upon arrival, the rig picks up the patient and travels to the destination facility where they would be off-loaded. The rig then returns to its home location for resupply and await its next dispatch.

There were a number of goals targeted for the simulation:

1. Identify the constraints caused by the existing six dispatch locations;
2. Determine the impact of weather conditions on system;
3. Propose locations for additional dispatch locations or re-alignment of existing locations, if necessary;
4. Identify any opportunities for changes to dispatch business rules to allow for better service; and
5. Evaluate the benefits of adding additional rigs at key locations, as well as helicopter transport capability.

2 SIMULATION APPROACH AND METHOD

Using Simcad Pro, an interactive on-the-fly simulator, a full representation of the transportation network was built that included:

- Origin and Destination facilities placed on a map of the region;
- Defined pathways connecting facilities with distances automatically calculated based on scale, and speeds based on road types;
- Ability to dynamically alter the impact of weather conditions while the simulation was running; and
- Rig dispatch logic based on proximity to origin and destination locations as well as current demand.

3 MODEL VALIDATION

In order to expedite model validation, one year's worth of historical transportation requests were loaded directly into the simulation. Existing business rules governing dispatch rules were incorporated. For the year evaluated, there were 5833 transfers completed. Using the historical transfer request times and existing business rules for dispatching rigs, the model collected and presented data on:

- patient wait times for transport;
- rig utilization;
- overall request to completion time for requested moves; and
- spaghetti diagrams showing the most common roadways traveled when completing the transfers.

4 SCENARIOS AND ANALYSIS

Simcad Pro, the interactive on-the-fly simulation tool used, was vital for the analysis phase, where the simulation used the same historical request information but allowed users to test different scenarios including:

- dispatch locations added or repositioned throughout the network;
- additional dispatches and or rigs deployed;
- changes made to business logic governing dispatched rigs; and
- increases in transfer demand from user identified locations by factors of 5, 10 and 15% to test the limits of the system.

5 SIMULATION RESULTS

Given the cost-benefit considerations and projected demand, it was recommended that the network implement a plan that would incorporate the expansion of two existing dispatch facilities to house an additional rig as opposed to building a new dispatch facility. The simulation model was designed to test additional scenarios based on more recent transfer data when available; as well as continued testing of alternative dispatch location priorities based on ongoing road construction projects throughout their environment.

REFERENCES

Adra, H. 2019 *Success With Simulation – A definitive guide to process improvement success using simulation for healthcare, manufacturing and warehousing*. 1st ed. Aurora: Adra
Simcad Pro – Interactive, On-The-Fly simulation software. https://www.createasoft.com