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Simulation Analyses and Optimises Healthcare Performance

The economic challenges besetting the healthcare industry in recent years has inspired architecture firms to find a way to use technology to help clients make objective, data-based decisions regarding new hospital and clinic projects. This service, called "Simulation," has proven effective in assessing the need for additions and renovations as well as helping plan new facilities. Using discrete event simulation software and statistical analysis tools, simulation teams can determine precisely the right blend of architectural space, medical equipment, IT and clinical communication technologies, staffing, and clinical processes that achieve each client's objectives. Evidence based architectural design applies of the science of analytics to all project decisions.

University Health Systems, San Antonio, Texas, is building a new 27,870 m² clinic in which three services were to be consolidated into 2,323 m². Physicians strongly believed that the chassis was undersized, so ultrasound technology was employed to tag and track all patients and staff to establish baseline current performance since process diagrams and EHR data were not available.

18 million data points gathered over six weeks enabled the hospital accurately define the duration of each patient type's visit. Simulation allayed physician fears and found that even under peak volume conditions, 25% of the 36 requested exam rooms were not required.

Patient Bed Floor Example

For a new 100,000+ m² academic medical centre in the US, patient floor simulations were used to optimally locate nursing stations, equipment supply rooms, and clean supply/medication rooms, as well as analyse the benefits of decentralised nursing stations. These simulations incorporated 56 nursing processes, each containing 10-15 individual steps. Nurse Server (NS) deployment was also simulated. A NS is a small, decentralised "clean supply/medication room" in or near every patient room.

The effects on nurses, pharmacy techs, linen techs, and patient care supply techs were analysed to obtain a holistic understanding of the decrease in travel time and distance for the nurses and the increase for support technicians.

Traditional architectural design never operationalises clinical work and results in poorly targeted solutions.

The medication distribution model was hybridised such that pharmacy techs would deliver robot-packaged, patient-specific 24 hour supplies of non-narcotic medications only to the clean supply/medication rooms, and the nurse would deliver the medications from there to the NS. ROI calculations show annual savings of nearly 488,318 euro, or more properly evaluated, 21,960 additional hours of nursing care. The cost for this increase is only 60,737 euro per year, or 2.77 euro per gained nursing hour.

Hospital OR Example

Baylor Regional Medical Center in Plano, Texas, wanted to hire an existing orthopaedic practice that would increase the existing 12- room OR case volume by 1,800 cases annually, or 30 percent. After one architectural firm concluded that a 2-3 million euro capital expansion was needed to relocate the PACU and to build two new ORs, Baylor turned to simulation for alternatives.

The medical centre believe that simulation helped them make the right business decisions. Simulation detailed opportunities to convert a dedicated cysto room to a general purpose OR, to shift small cases from the four large rooms supporting ortho cases, to slightly adjust the schedules of eight smaller ORs and the four large ortho rooms. These steps eliminated the need for OR suite construction.

Functionally linked departments must be simulated together as a system. However, simulation of central sterile processing showed a bottleneck that would require additional capacity to resolve.

Conclusions

Simulation can save 10 to 30 times its fee in construction cost and/or operational expense. Client current state performance data often takes two to four times longer to gather than clients initially estimate. Full BIM integration will allow simulation to perform better with accelerated project delivery methods.

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Figure 1. Conceptual Diagram of Patient and Staff Tracking System

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