Out of Africa: Using Computer Simulation to Improve Patient Flow in an Acute Care Hospital in Ghana

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Introduction: Crowding and limited resources have increased the strain on acute care facilities and emergency departments (EDs) worldwide, limiting their ability to provide timely and safe care. These problems are particularly prevalent in third world countries where infrastructure and resource limitations are ubiquitous. Discrete event simulation (DES) is a computer-based simulation tool that is used to predict how changes to complex healthcare delivery systems, such as EDs, impact operational performance. We developed a simulation model of an acute care hospital in Kintampo, Ghana and used the model to identify ways of improving patient throughput.

Methods: De-identified patient flow data from a time-and-motion study conducted at the hospital in 2009 were used to develop and verify the model. The data included course and times for 482 patients. Using the verified model, we tested whether modifying staffing start times for registration workers, history takers and physicians, without changing number of hours worked, would alter length of stay (LOS). We also explored whether adding extra staff hours would affect overall LOS. Lastly, we tested whether changing staff roles by combining two otherwise linear steps in the process, registration and history taking, affected patient throughput. Simulation experiments used a 2^k factorial design.

Results: The base-case (no change) scenario had a mean LOS of 281 minutes (95% CI 278, 283) with 19 patients not receiving complete care. Adding staffing, changing individual shift times in isolation, or changing staff roles did not affect patient LOS. When all shift start times were altered to synchronize with patient arrival patterns, mean LOS was reduced to 165 minutes (95% CI 162,168). When the two linear steps of history and registration positions were combined and shift times were synchronized to patient arrival, mean LOS was further reduced to 138 minutes (95% CI 135, 142).

Conclusions: Computer simulation modeling identified strategies for effectively improving patient throughput. Simply adding resources appeared to have little benefit. Matching demand (patient arrivals) with capacity (resources) was effective at improving patient throughput. Combining staff roles to minimize linear steps in the care process provided additional operational benefits beyond demand-capacity management.

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