

Chapter 3

Simulation Modeling of Healthcare Delivery

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ABSTRACT

Healthcare has delivered incredible improvements in diagnosis and treatment of diseases but faces challenges to improve the delivery of services. Healthcare is a complex system using expensive and scarce resources. Benchmarking, experience, and lean management techniques currently provide the basis for developing service delivery models and facility planning. Simulation modeling can supplement these methods to enable a better understanding of the complex systems involved. This provides the basis for developing and evaluating options to provide improved healthcare delivery. Simulation modeling enables a better understanding of the processes and the resources used in delivering healthcare services and improving healthcare delivery systems. Options to improve the cost effectiveness can be evaluated without experimenting with patients. This chapter reviews the current challenges and methods including the use of simulation modeling. Analysis of emergency patient flows through a major hospital shows the capability of simulation modeling to enable improvement of the healthcare delivery system. This chapter enables healthcare managers to understand the power simulation modeling brings to the improvement of healthcare delivery.

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INTRODUCTION

This chapter takes the perspective of a manager responsible for improving healthcare delivery. This may be management of a large health system; integrated healthcare service; hospital; health service or hospital department. Managers in such positions face the daily challenge of delivering services with highly variable and increasing demand; limited staff, equipment and facilities; increased expectations; changes in regulations and cost pressures. Managers need an analytical method, which improves understanding of the system, facilitates input from the disciplines involved and rigorous analysis to test options to improve delivery of health care. Current methods use experience, benchmarking, and process mapping to develop improvements. However, these methods lack a rigorous analytical method than enables analysis of the current systems and testing of options. Simulation modeling can supplement these methods to enable a better understanding of the complex systems involved. This provides the basis for developing and evaluating options to provide improved healthcare delivery.

The chapter commences with a review of the challenges facing health services, current methods and the emerging direction for delivery of health care. A brief description of simulation modeling provides the basis for an improved approach to the challenges. The approach focuses on the delivery of healthcare services rather than the health science or technology involved in providing health care. For example, the focus is on the staffing, equipment and facility requirements to deliver high quality healthcare and not the life science or medical technology involved in the diagnosis and treatment of disease.

The objective of the chapter is to enable readers too understand simulation modeling and its capability to improve delivery of healthcare services. The chapter also provides approaches, which can be used in improving healthcare delivery.

BACKGROUND

The background section provides the context for the example of using simulation modeling on the emergency patient flows through a major hospital.

Crossing the Quality Chasm: Identifying the Needs

There are a many reports that consider the challenges in providing health care. The Institute of Medicine (2001) report “*Crossing the Quality Chasm*” focused on the healthcare delivery system to provide preventative, acute, chronic and end of life healthcare for individuals.

The report summarized the US healthcare system as follows:

- *“The American healthcare delivery system is in need of fundamental change. Many patients, doctors, nurses, and healthcare leaders are concerned that the care delivered is not, essentially, the care we should receive. The frustration levels of both patients and clinicians have probably never been higher. Yet the problems remain. Healthcare today harms too frequently and routinely fails to deliver its potential benefits.”* (p 1)
- While healthcare knowledge and technology have advanced in the last 50 years, healthcare delivery has been unable to provide consistent high quality care. The system is frequently unable to translate knowledge into practice and apply new technology safely and appropriately. The healthcare delivery system does not make best use of the available resources.
- The delivery of safe healthcare is a major issue. It is estimated that in the US, between 44,000 to 98,000 patients die each year from errors in delivery of healthcare services. The total cost of preventable adverse events was estimated to be \$17 to

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