Chapter 6.9
Simulation Modeling as a Decision-Making Aid in Economic Evaluation for Randomized Clinical Trials

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ABSTRACT

This chapter reports on the use of simulation in supporting decision-making about what data to collect in a randomized clinical trial (RCT). We show how simulation also allows the identification of critical variables in the RCT by measuring their effects on the simulation model's "behavior." Healthcare systems pose many of the challenges, including difficulty in understanding the system being studied, uncertainty over which data to collect, and problems of communication between problem owners. In this chapter we show how simulation also allows the identification of critical variables in the RCT by measuring their effects on the simulation model's "behavior." The experience of developing the simulation model leads us to suggest simple but extremely valuable lessons. The first relates to the inclusion of stakeholders in the modeling process and the accessibility of the resulting models. The ownership and confidence felt by stakeholders in our case is, we feel, extremely important and may provide an example to others developing models.

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INTRODUCTION: CHALLENGES IN MODELING HEALTHCARE DECISION MAKING

In recent years the healthcare sector in the UK and around the world has witnessed a wave of organizational reforms and changes, which mirror trends in the business sector. As a result of such changes there has been an increase in the level of constraints against health services provision. This has meant that health managers and professionals are increasingly faced with difficult decisions (Delesie, 1998), trying to balance the competing pressures of meeting ever-increasing needs and demands of the population whilst keeping the cost of treatment under strict control (Lagergren, 1998). In this environment, professionals are constantly faced with situations where they have to make immediate decisions, which, in many cases, can affect the quality of life of patients.

To support decision-making, we often seek to develop models of the decision space, which will allow us to gain insight into the likely outcomes of different decisions that we may take. There are several reasons, however, that make this modeling difficult in the healthcare domain. Most contemporary healthcare systems are very complicated in terms of their structure, operation, and the diversity of people involved. Complexity often stems from the problems in healthcare lacking well-defined corners (Delesie 1998), with many interdependent entities competing for limited resources. This complexity can make it very difficult to predict the behavior of a healthcare system, since prediction is based on the application of collected historical data. Where a healthcare system is complex, it can be both difficult to determine the factors on which data collection should focus and challenging to define effective and appropriate data collection mechanisms. As a result, modelers tend to resort to assumptions in order to define the basic features of the problem, particularly when using mathematical models to represent the system. Another problem with healthcare systems is that they are multifaceted with different interdependent components. For example, in making decisions about patient treatment, the clinician has to look at the patient's profile alongside the cost of different treatments and the availability of resources to support such treatments. The involvement of different professionals in the healthcare system—such as clinicians and health managers—also makes modeling difficult (Delesie, 1998). These different stakeholders can have different views about the problem, expect different outcomes, and may make different decisions based on any model developed. This usually leaves the modeler with a major problem in integrating (and sometimes resolving) the different stakeholder perspectives involved in the problem.

The potential importance of modeling in supporting decision-making and the complexity of the situations that arise in healthcare suggest that studies of modeling approaches are worthwhile. The main purpose of modeling is to present an abstract picture of the real system and to examine the system's responses to different levels of inputs (Pidd, 1996). Many types of modeling are already used in healthcare problems. Lagergren (1998), for example, reports on a range of applications of modeling: in epidemiology for predicting future incidence, prevalence and mortality for broad sets of chronic diseases or for different specific diseases; for the evaluation of intervention strategies or disease control programs; in healthcare systems design, where the main concern is designing healthcare systems and estimating future resource needs as a training instrument for health managers; in healthcare systems operation, where the main objective of modeling is to improve performance by offering techniques for analyzing how existing resources could be used more efficiently; and in medical decision-making, where models are developed as support for analysis and decision-making in medical practice.

Given our emphasis on complexity and unpredictability, it is important to identify and study a case where these factors are prominent. A suitable