12
Applications of Simulation within the Healthcare Context

K. Katsaliaki\textsuperscript{1} and N. Mustafee\textsuperscript{2}
\textsuperscript{1}International Hellenic University, Thessaloniki, Greece
\textsuperscript{2}Swansea University, Swansea, Wales, UK

A large number of studies have applied simulation to a multitude of issues relating to healthcare. These studies have been published in a number of unrelated publishing outlets, which may hamper the widespread reference and use of such resources. In this paper, we analyse existing research in healthcare simulation in order to categorise and synthesise it in a meaningful manner. Hence, the aim of this paper is to conduct a review of the literature pertaining to simulation research within healthcare in order to ascertain its current development. A review of approximately 250 high-quality journal papers published between 1970 and 2007 on healthcare-related simulation research was conducted. The results present a classification of the healthcare publications according to the simulation techniques they employ; the impact of published literature in healthcare simulation; a report on demonstration and implementation of the studies’ results; the sources of funding; and the software used. Healthcare planners and researchers will benefit from this study by having ready access to an indicative article collection of simulation techniques applied to healthcare problems that are clustered under meaningful headings. This study facilitates the understanding of the potential of different simulation techniques in solving diverse healthcare problems.

12.1 Introduction

Healthcare needs grow and healthcare services become larger, more complex and costly (Eveborn \textit{et al}, 2006; Wand, 2009). Moreover, the

Reprinted from \textit{Journal of the Operational Research Society}, 62: 1431–1451, 2011, ‘Applications of Simulation within the Healthcare Context’, by K. Katsaliaki and N. Mustafee. With kind permission from Operational Research Society Ltd. All rights reserved.
intrinsic uncertainty of healthcare demands and outcomes dictates that healthcare policy and management should be based on the evidence of its potential to tackle these stochastic problems. It seems apparent that computer modelling should be valuable in providing evidence and insights in coping with these systems. They can be used to forecast the outcome of a change in strategy or predict and evaluate the implications of the implementation of an alternative policy (Wierzbicki, 2007). The use of modelling in healthcare is not limited to the management of activities necessary to deliver care alone. It is also used for the study of several topics related to healthcare, for example, air pollution, pharmacokinetics and food poisoning. In this paper, we aim at profiling studies that have designed, applied, described, analysed or evaluated healthcare problems with the use of simulation modelling.

Computer simulation is a decision support technique that allows stakeholders to conduct experiments with models that represent real-world systems of interest (Pidd, 2004). It can be used as an alternative to ‘learning by doing’ or empirical research (Royston, 1999). Furthermore, simulation modelling gives stakeholders the opportunity to participate in model development and, hopefully, gain a deeper understanding of the problems they face. As a result, decision makers and stakeholders can gain a new perspective on the relationships between the given parameters, the level of systems’ performance, the cost-effectiveness and its quality, or risk association.

In the field of Operations Management, simulation is recognised as the second most widely used technique after ‘Modelling’ (Amoako-Gympah and Meredith, 1989; Pannirselvam et al, 1999). Thus far, there have been a number of reviews in the literature on the applications of simulation to health. Fone et al (2003) have conducted a systematic review of the use and value of computer simulation methods in population health and healthcare. Eldabi et al (2007) reviewed the application of a diverse range of simulation techniques in healthcare settings. Brennan and Akehurst (2000) and Barrios et al (2008) considered the application of simulation in the economic evaluation of health technologies and health products as well as a proposed method for the evaluation of pharmacoeconomic models (Hay, 2004). Dexter (1999) includes a review of computer simulation and patient appointment systems. A number of reviews have focused on the applications of Discrete-Event Simulation (DES) in healthcare in general (England and Roberts, 1978), and more specifically in health clinics (Jun et al, 1999) and healthcare capacity management (Smith-Daniels et al, 1988). Hollocks (2006) gives a personal review of the use of Discrete Event Simulation in health among other fields.