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System Dynamics Applications to European Healthcare Issues

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Taking a European perspective, a review is made of some system dynamics models which address health care issues. Suggestions are made for the types of role which these models should take, bearing in mind the strategic orientation of system dynamics modelling. Examples are described of qualitative models where influence diagrams are the main analytical tool. Quantitative system dynamics models have a contribution to make in epidemiological studies and have been used to analyse the AIDS epidemic. A detailed example of one aspect of model formulation is given. This concerns the AIDS incubation time distribution and shows how real-world complications arising from virological staging and treatment effects are handled in a model of AIDS spread.

13.1 Introduction

As a component of the public sector, health care looms large. All European governments provide the great bulk of health care through the public purse and in the UK this means an estimated budget of £45 billion for 1998 (or approximately 6% of GDP)\(^1\) and employment for around one million people.

The health service in the UK has, over the past ten years, undergone something of a transformation in operation. It has witnessed the introduction of the ‘internal market’ and the distinction between ‘purchasers’ of health care, mainly in primary care, and ‘providers’, such as hospitals and medical specialities. Funding problems have been endemic: an ageing...
population and the costs of modern health technology have served to bring into sharp focus the political issue of the extent to which general tax rates ought to be raised to finance the burgeoning health budget.

In this climate there is a pressing need for tools of assessment and evaluation for both strategic and tactical issues. Operational Research and statistical techniques have a long track record of use in health care settings, pertinent examples being in out-patient appointment systems and departmental facilities management. Yet OR techniques, despite their track record of success in health problems, have primarily addressed tactical and operational matters. With system dynamics there exists a modelling methodology which is suited to handling strategic policy matters and it is the purpose of this paper to provide illustrations of just what can be achieved in this regard within a health care framework.

The paper is organised as follows. A review is made of possible roles which system dynamics models can take with special reference to health care matters. Following this, coverage is given to qualitative (influence diagram) approaches in three health applications: community care, short-stay psychiatric patients and the waiting list phenomenon. Finally, a more detailed account is provided on one facet of a quantitative system dynamics model in the field of epidemiology, namely the formulation of the incubation distribution within the author's model of the spread of AIDS.

What follows is not claimed to be a comprehensive review of health care modelling. For a start its geographic focus is solely the UK and Europe. However, given this context, an attempt has been made to collect all the health-related references arising in the mainstream constituency of system dynamics literature. The purpose of the paper is to review current work but also to stimulate the system dynamics community into becoming more involved in what is a topical feature of most societies, often with a large budget commitment: health care is always in the public eye.

13.2 Roles for system dynamics models in health care

Projects for which system dynamics is most properly utilised adopt a vista congruent with the methodology; a vista appropriate to a strategic orientation. This is synonymous with examining aggregate flows of people and resources in the region, hospital or whatever. Therefore studies which inherently involve patient flows and money flows at a strategic level of aggregation are obvious candidates for a system dynamics framework to the analysis. Three examples in this category are the