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A software tool to aid long-term care budget planning at local authority level

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ABSTRACT

Objective: Local authorities face real challenges when it comes to annual budget planning for funding the system of long-term care. Uncertainty about the long-term cost of caring for current residents in the system, in addition to unknown future admissions, have made the tasks of local authority budget managers very complex and demanding. In this paper, we present a software implementation of a novel forecasting framework developed by the authors to provide useful information to local authority budget planners involved in long-term care.

Methods: The tool is built upon a forecasting framework, which combines unit costs of care with an estimated underlying survival model for publicly funded residents in long-term care, to provide forecasts of the cost of maintaining the group of elderly people who are currently in long-term care (referred to as known commitments) for a period of time. A prototype version of the software tool, which was created and tested in collaboration with an English borough, allows user interaction via a friendly graphical interface that guides through a set of screens of options in a familiar wizard fashion.

Results and discussion: Feedback from care planners and managers show that the tool helps them gain better understanding of the patterns of length-of-stay of residents under their care, and provides quantitative inputs into their decision making on budget planning for long-term care. The development of the software tool brings advanced modelling techniques out of research papers into the hands of decision makers in the public sector and contributes to improving the delivery of long-term care.

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1. Introduction

As people get older, activities of daily living, such as feeding, toileting and self-care, can become difficult. In general, long-term care (LTC), which is provided to people who are unable to look after themselves without some degree of support, embraces all forms of continuous, social, personal and nursing care, and associated domestic services [1]. In this paper, the term LTC refers to residential care (RC) and nursing care (NC) provided in institutional care homes, e.g. residential homes and nursing homes. As the world population is ageing, it is generally believed that LTC will become an even more important issue for an ageing society [2]. Governments around the world have been alerted with the potential difficulties in funding and managing LTC, and are attempting to address the difficulties in their own ways.

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Local authorities in England play a major role in running the system of LTC. Under current regulations (i.e. the 1990 NHS and Community Care Act and the Care Standard Act 2000), local authorities are responsible for the placement and finance of all publicly funded residents in LTC that conforms to national standards. The ability to discharge elderly patients to LTC is essential in the planning and running of acute hospital care. Under the Community Care (Delayed Discharges, etc.) Act 2003, local authorities have been facing financial penalties since January 2004 for failing to provide vacancies in institutional care homes for hospital discharges [3].

Given limited resources available, local authorities have a keen interest in knowing the behaviour of the LTC system, in particular, how long residents stay in the system, and ultimately, how much the system will cost. From the prospective of local authorities, the emphasis is placed on the residents who require funding support from the public. A national survey [4] in England showed that 73% of the residents admitted to LTC in 1996 were publicly funded, and most of them were there on a permanent basis, i.e. not expected to go back to their own homes.

Extensive studies have been conducted in Britain to develop macro models for projecting the demand and hence the cost of LTC at the national level [5,6]. This type of model, which adopts a "whole system" approach, is typically useful for strategic planning for a nation.

However, at a local level, a methodology that takes into account local characteristics in its forecast will be more suitable. Especially, as far as cost is concerned, local authorities need a method that can help their budget planning and allow evaluation of the potential effects of changes in regulations and financial context on the use of resources and costs. Good budget planning is essential to ensure the successful delivery of LTC that balances demand and provision.

In previous studies [7,8], we developed a forecasting framework for predicting the cost of LTC arising from known commitments from a local authority perspective. The term known commitments refers to the group of publicly funded residents currently in the LTC system. Knowing the projected cost associated with this group of residents is of particular interest to local authorities as it corresponds to the burden they cannot escape. This information will enable local authorities to identify the fraction of the budget that is already committed due to past admission decisions. Given this information, local authorities will also have a fair idea about the resources available for new admissions in a financial year.

In Section 2, we briefly describe the forecasting framework and its data requirement. In Section 3, we describe a software implementation of the framework, which was developed in collaboration with an English borough. In Section 4, we demonstrate the use of the tool based on data from the borough. The usefulness of such a software tool is discussed in Section 5.

2. Methods and data

In England, RC is intended for older people who are frail but still able to manage their activities of daily living; while NC is for older people who are medically stable and have a greater degree of physical and mental disabilities. Residents can be admitted to RC or NC directly. RC residents may be transferred to NC if their conditions deteriorate to such extent that RC is no longer appropriate for their needs. For publicly funded residents, discharges from LTC are predominantly by death, and transfers from NC to RC rarely happen for this group of residents [9].

2.1. General forecasting framework

We are interested in predicting the total cost of maintaining the known commitment of a local authority for a period of time. Formally, we seek to forecast the total cost of maintaining for t units of time (chosen to be days without loss of generality) a group of publicly funded residents present in LTC at time c. The total cost $TC(t)$ of maintaining this group of residents is simply the sum of the cost incurred by each individual in the group during the forecasting interval $[c,c+t]$. Whereas the cost incurred by a resident during the interval is the sum of costs for RC and NC. Therefore, assuming there are M_R and M_N number of residents in RC and NC, respectively, the total cost $TC(t)$ is given as:

$$TC(t) = \sum_{i=1}^{M_R} K(X_i, Y_i) + \sum_{j=1}^{M_N} K(0, Y_j),$$

where X_i and Y_i are random variables representing the time spent during the forecasting interval in RC and NC, respectively; and the cost incurred by a resident staying X days in RC and Y days in NC during the forecasting interval is defined as $K(X,Y) = K_R(X) + K_N(Y)$, that is the sum of the costs in RC and NC. From a forecasting perspective, we are interested in the expected total cost $E[TC(t)]$, where expectation takes into account future uncertainties during the forecasting interval, namely (i) the survival pattern of residents in the system, (ii) the potential transfer of RC residents to NC, and (iii) future increases in unit prices of care in both RC and NC. Therefore, there are two distinctive components of the framework: a model describing the movements of publicly funded residents in LTC, and the future development of unit cost of care in RC and NC. In the following, we discuss these two components of the forecasting framework. For a more detailed description of the forecasting framework, see ref. [7].

2.2. Model for movements of publicly funded residents in LTC

The forecasting framework builds on a model that describes the movements of publicly funded residents in LTC. Specifically, this model describes the length-of-stay (or survival) pattern of the residents in RC and NC, and the probability of transfer from RC to NC. In a previous study [8], we presented a continuous-time Markov model for the movements of residents within and between RC and NC. Briefly, the model uses a combination of a short-stay state and a long-stay state to capture the movements of residents (see Fig. 1). For instance, a person admitted to RC might stay for a short period of time, then is either discharged or transferred to NC; or the person might settle down and become a long-stay resident in RC; and eventually is either discharged or transferred to NC for

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