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Implications of long-term care capacity response policies for an aging population: A simulation analysis



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ABSTRACT

Introduction: The demand for long-term care (LTC) services is likely to increase as a population ages. Keeping pace with rising demand for LTC poses a key challenge for health systems and policymakers, who may be slow to scale up capacity. Given that Singapore is likely to face increasing demand for both acute and LTC services, this paper examines the dynamic impact of different LTC capacity response policies, which differ in the amount of time over which LTC capacity is increased, on acute care utilization and the demand for LTC and acute care professionals.

Methods: The modeling methodology of System Dynamics (SD) was applied to create a simplified, aggregate, computer simulation model for policy exploration. This model stimulates the interaction between persons with LTC needs (i.e., elderly individuals aged 65 years and older who have functional limitations that require human assistance) and the capacity of the healthcare system (i.e., acute and LTC services, including community-based and institutional care) to provide care. Because the model is intended for policy exploration, stylized numbers were used as model inputs. To discern policy effects, the model was initialized in a steady state. The steady state was disturbed by doubling the number of people needing LTC over the 30-year simulation time. Under this demand change scenario, the effects of various LTC capacity response policies were studied and sensitivity analyses were performed.

Results: Compared to proactive and quick adjustment LTC capacity response policies, slower adjustment LTC capacity response policies (i.e., those for which the time to change LTC capacity is longer) tend to shift care demands to the acute care sector and increase total care needs.

Conclusions: Greater attention to demand in the acute care sector relative to demand for LTC may result in over-building acute care facilities and filling them with individuals whose needs are better suited for LTC. Policymakers must be equally proactive in expanding LTC capacity, lest unsustainable acute care utilization and significant deficits in the number of healthcare professionals arise. Delaying LTC expansion could, for example, lead to increased healthcare expenditure and longer wait lists for LTC and acute care patients.

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1. Introduction

Between now and 2050, the number of individuals 65 years of age and older in Singapore is projected to rise from less than half a million to over one and a half million [1,2]. As the population of older individuals grows, the demand for long-term care (LTC) services, consisting of home- and community-based services and institutional care, is expected to increase considerably [3]. Already, Singapore is experiencing a shortage of healthcare professionals across care venues [4,5], and the wait list for nursing homes is sizeable [6].

Keeping pace with rising healthcare demand poses a key challenge for policymakers, and the Singapore Ministry of Health (MOH) and the Agency for Integrated Care (AIC; the agency responsible for the placement of individuals with LTC needs) are looking for ways to address the growing demands. In order to minimize LTC costs, Singapore has adopted a LTC policy that encourages individuals to “age in place” [7,8]. As a result of this policy preference, it is estimated that, by 2030, about 90 percent of elderly individuals with disabilities will reside at home without LTC services due to inadequate nursing home beds supply and relatively low uptake of home- and community-based services [9], partly due to the availability of less costly albeit untrained foreign domestic workers (FDWs). Given the disproportionately high healthcare utilization rate of older individuals [10–15], especially for those with disabilities [16], the demand for acute care services is expected to rise as greater numbers of older individuals rely on inpatient hospital stays, outpatient services, and emergency room visits to meet their LTC needs.

Accordingly, Singapore is planning a rapid expansion of its acute care sector, including tripling the number of community hospital (i.e., hospitals that provide short-term therapy and treatment following discharge from an acute hospital) beds and increasing the number of acute hospital (i.e., those intended for intense medical treatment and surgeries) beds by 30 percent by 2020 [6]. However, the expansion of the LTC sector is occurring more slowly. Although the AIC is working on developing a range of home- and community-based services, including day rehabilitation centers, day care centers for dementia patients, and home medical and nursing care, the capacity of these services remains low given the number of Singaporeans aged 65 years and older. In addition, relative to the projected number of individuals with nursing home care needs [17], the Singapore government has proposed only modest increases in the number of nursing home beds between now and 2020 [6].

Given that Singapore is likely to face increasing demands for both acute and LTC services, this paper examines the dynamic impact of different LTC capacity response policies (i.e., based on the amount of time taken to increase LTC capacity) on acute care utilization and the demand for LTC and acute care healthcare professionals. Although this study focuses on the Singapore context, the general insights presented herein are potentially broadly applicable to other countries undergoing a similar demographic transition, including, among others, Japan, South Korea, and Taiwan [18,19].

2. Methods

Based on discussions with healthcare planners from the Singapore MOH as well as care providers, patient placement agencies and representatives of LTC services, a System Dynamics (SD) model [20,21] was developed to capture and represent the interaction between persons with LTC needs and the capacity of the healthcare system to provide care. SD offers a practical approach to engaging stakeholders in understanding the behavior of real-world systems over time in a way that allows alternative policies and scenarios to be tested systematically in order to answer both “what if” and “why” questions [22].

A substantial and expanding academic literature supports SD models as being useful in assisting policy formulation in healthcare and addressing the dynamic complexity that characterizes many public health issues [22–27]. SD modeling has been applied to issues of population health since the 1970s [22] and, more recently, has also been applied to human resource issues in healthcare. For example, Barber and López-Valcárcel [28] used an SD model to simulate the evolution of supply and demand of medical specialists in Spain, and Masnick and McDonnell [29] used an SD model to link population and medical needs to the workload of a clinical workforce.

2.1. Model structure

The model structure used in this paper represents the demand and supply of LTC services which is key to understanding the impact of a demand–supply gap on acute care utilization and the demand for healthcare professionals (Fig. 1; see Appendix, Table 1 for a complete list of model equations and inputs). The use of care services by LTC patients (i.e., persons with LTC needs) is the main interest in this model. Evidently, acute care services are also used by other patients. However, having assumed that the demand for acute care by persons without LTC needs would not change over the simulation period and that the focus of the work was on the changes in outcomes (i.e., total acute care visits, total professionals needed, deficit of LTC professionals, and deficit of acute care professionals) attributable to LTC capacity response policies, the demand for acute care by persons without LTC needs did not vary in the model. Given this assumption, the numbers derived from the SD model present the best-case scenario since any ‘competition’ or increase in demand from persons without LTC needs will result in an even graver situation. Results are presented on a per-year basis; however, the model is simulated in continuous time with a solution interval of 1/16 year.

In the model, the population of interest (i.e., persons with LTC needs) is comprised of elderly individuals (aged 65 years and older) who have functional limitations that require human assistance. Naturally, admission to LTC facilities depends on the availability of such facilities and can increase only when LTC capacity increases. LTC capacity (supply) is modeled as a delayed response (reflective of the time required to change capacity) to the number of persons with LTC needs (demand). In the model, a shorter

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