1. Introduction

Large growth in the over-65 population is expected over the next 20 years, and the number of people over 85, for example, is expected to nearly treble in New Zealand (Statistics New Zealand, 2007). Older people are a vulnerable population with complex and interacting needs and often require support from a wide range of professionals in the health, residential, social service and government sectors. Trebled demand could overwhelm the health sectors unless future services are innovatively managed.

Internationally, there is criticism of the "insensitive, dehumanising and simply poor-quality services" available (Glendinning, 2001) including the "unacceptable variations according to where older people live" (Warden, 1998). Furthermore, future generations are expected to have increasingly higher expectations about the quality of health care and supports, and personal autonomy (Fitzgerald, 2007).

In Counties Manukau District Health Board (CMDHB), there is currently 3.9% of the total population in subsidised residential care. There is pressure on this proportion to increase from an ageing population, but the impact will be mitigated by the strong trend towards supporting people in their own homes ('ageing in place' is the basis of the Counties Manukau Health of Older People (HOP) Action Plan (Counties Manukau District Health Board, 2006)). Currently 77% of all CMDHB HOP expenditure is on external residential care.

HOP is one of the main programmes currently funded by the DHBs. The scope of this programme crosses over nearly all sectors, including primary and secondary healthcare, community and institutional care. Its population is also involved in nearly all other funded programmes, such as Mental Health programme, Chronic Care Management programme, and Let's Beat Diabetes programme. Therefore, the policies made for HOP have multiple effects on other sectors in the system; similarly policies applied to other areas have consequences on HOP. Therefore the older people's sector is a rich and complex policy environment

2. Objective

System modelling is a part of CMDHB's Older People's Strategy to plan future services for older people. The system dynamic model focuses on the coordination and integration across the continuum of services to ensure the variety and capacity of services meet their assessed needs. CMDHB is already committed to sharing information on occupancy, demographic trends, service user preferences, as well as the DHB funding plans. It operates long-term partnerships with stakeholders in an open market approach to residential care.

The service mix planning model is designed to provide a shared planning tool for all key stakeholders to provide information that indicates expected future preferences of service users and funders. It covers all modes of support, including home-based, community support, supported housing and residential care, and hospital-based care.

Systems thinking (ST) and system dynamics (SD) modelling are expected to provide the sectors with valuable insights and tools to make decisions. These tools have been developing over the last 60 years. Systems dynamic modelling in particular has been successfully used in many health environments, primarily in hospital and residential services (Homer, Hirsch, Minnitii, & Pierson, 2004; Kim & Goggi, 2001; Medicine, 2005; Taylor, Dangerfield, & Grand, 2005), because it "permits planners to study" healthcare "problems and find leverage points where investment of healthcare resources brings the greatest return" (Allen, 1998, p. 7). It is recognised as "a mature and powerful tool" for the healthcare system "to test how different factors may improve efficiency, effectiveness and equity in situations where it is not possible to conduct real-world experiments" (Gray et al., 2006, p. 453). It "provides a method of conducting policy experiments at low risk and cost with instant results" (Gray et al., 2006, p. 456). Using ST/SD models for this study has two key advantages that are not generally found in other policy analysis methods. First, "it permits direct analysis of the complicated programmatic and behavioural interactions that abound in social programs". Second, "it permits detailed and flexible analyses of the distributional impacts of policies" (Citro & Hanushek, n.a., p. 15).

3. Methodology

This project first developed a strategic inter-agency Steering Group to oversee the model-building process and then identify model goals, parameters and principles. Following this, an operational group was formed to develop and test assumptions about the main model elements, concentrating on service pathways.

The Steering Group specified and agreed the model structure before the process, variables to be used and the funding flow between services were mapped. The detail of the model was then developed, consulting a range of operational staff, using proxy measures as needed. All base data is from 2006. The model has been tested with the Steering Group and key operational staff.

The model includes variables that change or remain static regardless of CMDHB actions, those that can be influenced by CMDHB and those that are based on CMDHB's view of best practice.

Scenarios involving the different key variables have been run to identify the impact of each independently and in combination with others.

It is important to note that Quality-Adjusted Life Years (QALYs) and Service Utilisation have not been included in this model (shown as the gray coloured box on Figure 1 and Figure 2) because of the level of complexity involved in determining them. QALYs are a way of measuring both the quality and the quantity of life lived, as a means of quantifying in benefit a medical intervention. While this is an important component missing at present, it could be undertaken in an expanded version of the model.

Figure 1: Mental Model of HOP

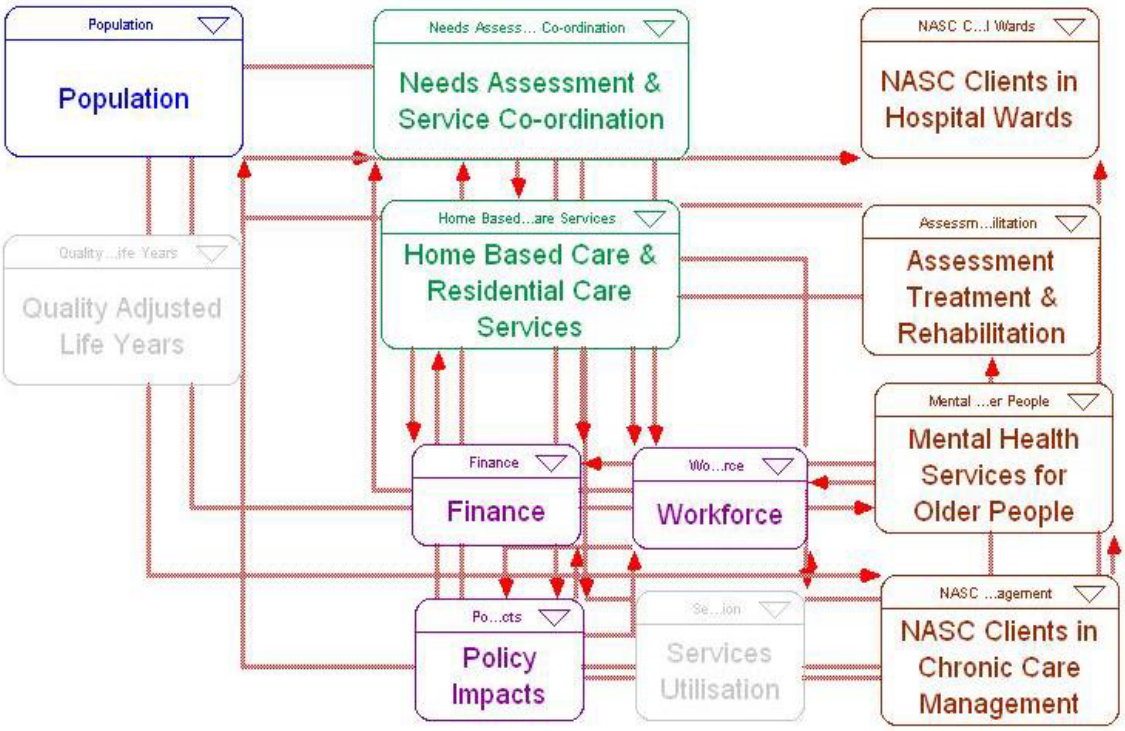


Figure 2: System Dynamics Model of HOP

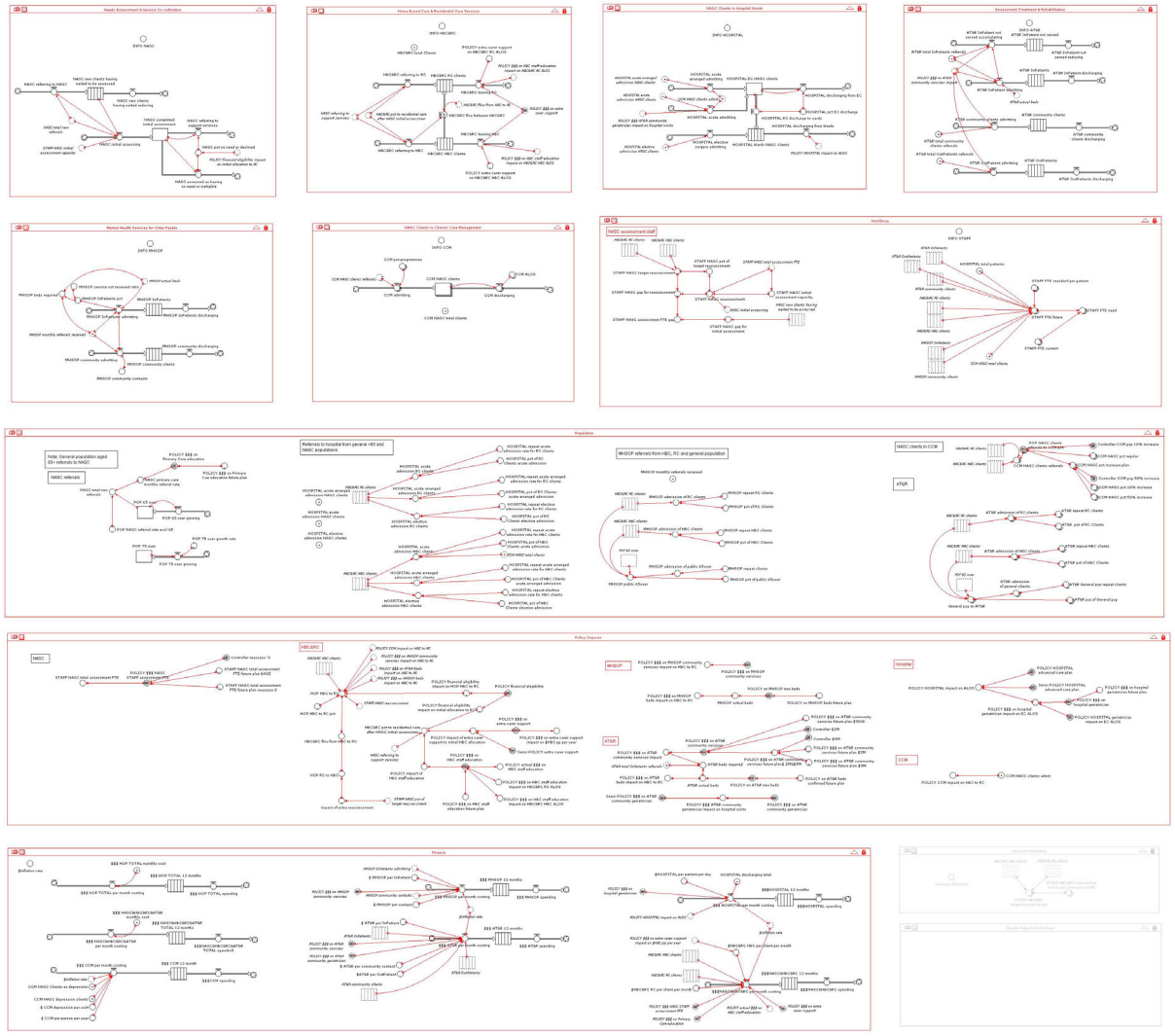
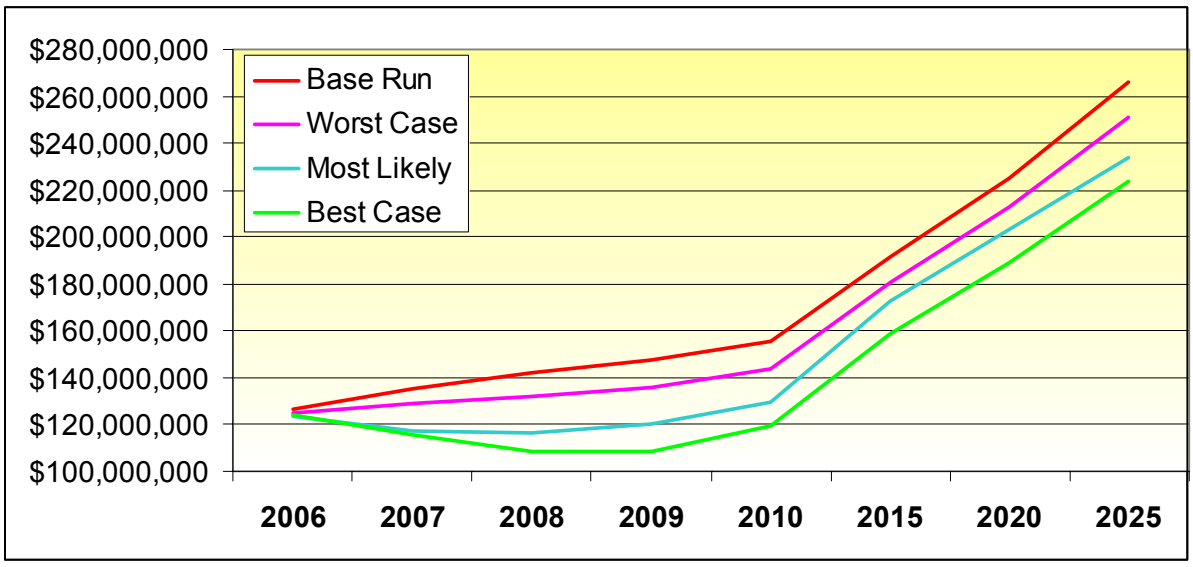


Figure 3: Total Cost Comparison



4. Results and Findings

Three combinations of all scenarios have been developed. In the "worst case", all the most conservative views on the impact of variables have been used. The "best case" has included all the most optimistic views. Identified in the Figure 3 are the overall costs of the scenarios (with 2.6% inflation on costs every year). There are some small savings quickly and significant long-term savings from all the scenarios. The model has also shown clearly the intensive need for workforce increases in home-based care and residential care over time.

The various policies have been developed and tested in the model, their impacts have been shown in the Figure 4.

Figure 4: Decision Making Variables and their impacts

Decision Making Variables in the Model	Impact on Cost	Impact on Client Health
Providing extra carer support for home-based clients	High reduction in costs with high investment long term	High
Enhancing the NASC capacity to (re)assess need to ensure appropriate service	Negative initially but little impact long term	Medium
GP education to ensure they are aware of NASC and how to refer patients	Neutral	Low
Advanced care planning for all patients aged over 65 years	Medium to high reduction in costs	Low to Medium
Increases in community support for AT&R patients	Negative with significantly more clients served	High or Medium
Increases in community support for MHSOP clients	High	High or Medium
The reorganisation of one specific ward for older people within the hospital(from within existing resources), staffed by an additional geriatrician and nurse	High	Medium or High
Provision of a community geriatric service to support primary care	Low to Medium	Medium or High
Enhanced access to Chronic Care Management (CCM)	Neutral	High

This model has shown that the following investments will have the most significant impact on the reduction of costs and health of older people receiving services:

- Providing significant extra carer support for home-based clients ($3 – 5 million a year)
- Increases in community support for MHSOP clients over the longer term
- The reorganisation of one specific ward for older people within the hospital (from within existing resources), staffed by an additional geriatrician and nurse

  The above investments are also expected to have high impacts on client health.

- Advanced care planning for all patients aged over 65 years to ensure their wishes around medical treatment are followed.

The following investments are expected to have a high impact on client health but little impact on costs:

- Provision of a community geriatric service to support primary care
- Enhanced access to Chronic Care Management (CCM)

Increases in community support for AT&R patients are expected to actually cost more but serve more patients and have a positive impact on client health.

5. Conclusion

Given the aging population, determining the future funding mix for older people's services is critical for Counties Manukau District Health Board (CMDHB), and indeed all older people's services worldwide, to optimise services within severely constrained resources. This system dynamic model creates insight in policies that can or will influence the Health of Older People services structure by influencing the decisions on investment. The SD policy model leads to a deeper understanding and a greater ability to manage aging healthcare dynamic issues.

The model building process in this study involved intensive group meetings and workshops, where sector representatives, including consumer representatives, contributed their thinking to the model. The results from the model facilitated. an organisational and inter-sectoral learning process, which is a departure from conventional 'technical' approach to model building. Thus the ST/SD approach not only provides an integrative model for policy making, it creates a learning environment for the stakeholders to examine and test their mental models. Also ongoing discussion is needed to ensure the model is used effectively as a tool for service development.

In addition, the current model can be developed further to identify more precisely the current and target proportion of the older population that is supported by each type of service, and how current delivery patterns compare with service needs. It will allow

interactive modelling over time to test how different factors improve efficiency, effectiveness and equity.

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