The dynamics of local rules in hospital admission processes

BEVERLY C. WALKER AND TIM HASLETT

Beverly C. Walker and Tim Haslett are with the Department of Management, Monash University

Abstract

This paper reports on research into admission practices at a sub acute extended care hospital. A system dynamics simulation model of the patient flow from feeder hospitals to the hospital was built to show the impact of the local rules used by the medical registrar. Local rules are behaviours that are local, and often idiosyncratic, adaptations to the local environment. The model showed these adaptations had a significant impact on the acuity of patients being admitted as a result of the separation policies of the feeder hospitals. This patient mix in turn affected the hospital ability to meet its budget.

Definition of the Problem

Public acute hospitals in Victoria, Australia are funded on a case mix formula based on Diagnosis Related Groups (DRGs) that provide a framework for what will be funded and under what conditions (Podger, 1999). DRGs were introduced in 1993 following a change in Government and a subsequent change in the health policy context and budget, with the aim to improve efficiency and reduce waiting lists (Duckett, 1994). The case mix approach now extends to inpatient, outpatient and rehabilitation services (McNair and Duckett, 2002). The history of the extended use and issues related to case mix funding is well documented in the Australian Health Review by Duckett, Hindle and others.

Sub-acute aged care and rehabilitation hospitals are funded on a per diem basis by stream of care. Service targets and funding are renegotiated each year with an increasing emphasis on reducing the length of stay and bed substitution. For a discussion of this funding model see Braithwaite (1994). This paper discusses the experience of group modelling (Andersen and Richardson, 1980) that resulted in a System Dynamic simulation model that identified the impact of the use of local rules used by the medical admitting officer.

Waiting lists constitute a major operational and public relations problem for hospitals (Mullen, 1993, Brookfield, 1992). Purnell (1995) surveyed 309 hospitals in the US for the impact of waiting times in emergency departments and general overcrowding that resulted in increased nursing care time and client dissatisfaction. Iversen (2000) used a queuing model to examine the contribution of internal markets to a cost-effective allocation of resources in a hospital sector with waiting lists. Resource allocation became an issue when waiting lists in the acute care centre show signs of unstable fluctuations.

The context for this study was an extended care facility that provided a range of sub acute, community and residential services. Bed occupancy rates in the sub acute services that included rehabilitation, geriatric assessment and management, and nursing home type services had shown substantial variation over 12 to 24 months. Planned and unplanned bed reductions, the ability to access two acute beds in a feeder hospital and bed substitution with domiciliary-based services had all impacted on the waiting list. This led to large fluctuations in waiting lists, which often had no patients listed for admission.

Walker and Haslett (2001) demonstrated that a reduction in the waiting list resulted in empty beds and had the counter-intuitive effect of transfer of patients from the acute feeder hospitals earlier in their recovery resulting in consequent increase in (unfunded) patient acuity in the sub acute facility. This increase in acuity also led to increased readmission to the acute hospital for management of an exacerbation of the patient's illness. It was also common for patients to be transported back to the acute hospital on a daily basis for extensive clinical tests prescribed and scheduled prior to transfer to the sub-acute hospital. These costs were borne by the sub acute facility.

Another factor impacting on the waiting list was the increase in the rate of discharge of patients requiring long-term residential care. Over a three-year period, the availability of long-term care had increased markedly, reducing the need to keep patients in the sub-acute hospital. This in turn impacted occupancy rates.

As factors at the referral (pre-admission), the admission and separation points of the sub-acute in-patient process were thought to impact on the rate of admission and bed occupancy, a decision was taken to examine the processes and test alternative scenarios.

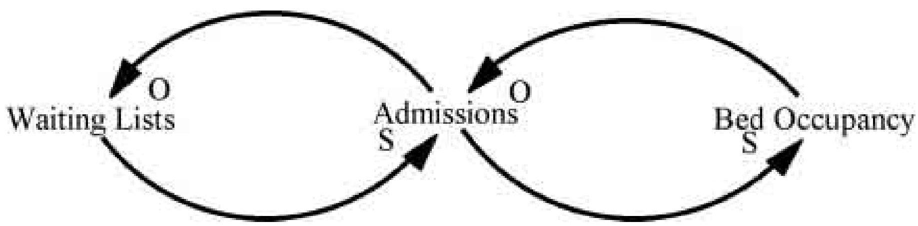
Project Methodology

The methodology used in this project was System Dynamic Modelling (Forrester, 1961, 1967, 1973; Morecroft & Sterman, 1994; Vennix, 1996) using the computer based simulation modelling package, ithink. The success of this approach in simulating public and private sector policy issues has been reported extensively in the literature over the last twenty years, in the area specific to this study. For example, Blake and Carter (1996) used discrete event simulation to model emergency room wait times in Ontario. Worthington (1991) used stock - flow models, similar to those used in this study to build "what-if" simulations of waiting lists.

System Dynamics Modelling has been used across a wide range of fields. In 1999, the System Dynamics Review published a special edition on Health and Health Care dynamics. In addition, other recent special editions have included Sustainable Development (14: 3, 1998), Consulting and Practice (17: 3, 2001), Small to Medium Enterprises (18: 3, 2002). Sterman (2000: 5) cites both Forrester (1971) and Meadows (1982) who described the role of modelling as identifying policy resistance, unintended consequences, and counter-intuitive behaviour in social systems. The social system in discussion in this paper is a hospital admissions system and the modelling identifies the unintended consequences of informal admissions policies.

There are two major tools in System Dynamics Modelling: causal diagrams and stock-flow-rate models. Readers wishing to know more of these processes are referred to John Sterman's (2000) Business Dynamics which provides an excellent introduction to both of these techniques which are used in this paper. Causal loop diagrams are normally developed on a white board and are used to establish causal relationships where relative changes to dependent and independent variables are mapped. An example of a causal loop diagram is shown in Figure 1.

Figure 1: Causal Loop Diagram of an Admission Process



This figure demonstrates the causal relationships, indicated by the arrows, between Waiting Lists, Admissions and Bed Occupancy. As Admissions go up, Waiting Lists go down. This is indicated by an "O" for opposite at the arrowhead. As Waiting Lists go up, Admissions go up, indicated by an "S" for same. The same nomenclature applies in the other loop. As Admissions go up, Bed Occupancy goes up and as Bed Occupancy goes up, Admissions go down.

To capture the dynamics of such a system it is necessary to build a computer simulation using a stock-flow-rate model. The first difference between a causal loop diagram and stock-flow-rate diagram is that the latter captures accumulations in 'stocks'. The best way to describe stocks is to liken the concept to a bathtub with a tap as the inflow, the plug hole is the outflow and the bath itself is the accumulation or stock. In a hospital example, a simple stock-flow-rate model is shown in Figure 2. Here the patients flow through a Referral process to accumulate on a Waiting List. The Admissions flow accumulates patients in beds while they stay in hospital and then they flow out through Separations.

Figure 2: Stock-Flow Diagram of the Admissions and Discharge Process

This diagram captures the same dynamics as the causal loop diagram in Figure 1. Admissions decrease Waiting Lists because it is an outflow from Waiting Lists. It is also an inflow to Bed Occupants, so increases that stock. The iconography of Figure 2 is used in building the computer simulation model shown in Figure 3.

There were four main reasons for using this simulation modelling. The first was that it was possible to capture the systemic complexities generated through feedback processes, particularly in queuing. This was particularly important to understand the way in which the feeder network responded to changes in the queues for the acute care facilities. The second was management involvement in group model building, where a specialist modeller worked with managers to elicit the structure underlying the admission process. The intention here was to ensure ownership of the model by the end users. The third was the user-friendly interface that could be used by managers with minimal or no experience in systems modelling. Run time versions of the model could also be made available to managers interested in improving the system. Finally, the scenario testing interface allowed managers to run multiple "what – if" scenarios where the parameters of the system could be changed to test the impact on the total system.

Experience has shown that, while some managers in an organisation may have modelling experience, they rarely have time to devote to building models. The first author had experience in using modelling as a change process and provided the gatekeeper link between the modeller and the staff (Richardson and Andersen 1980).

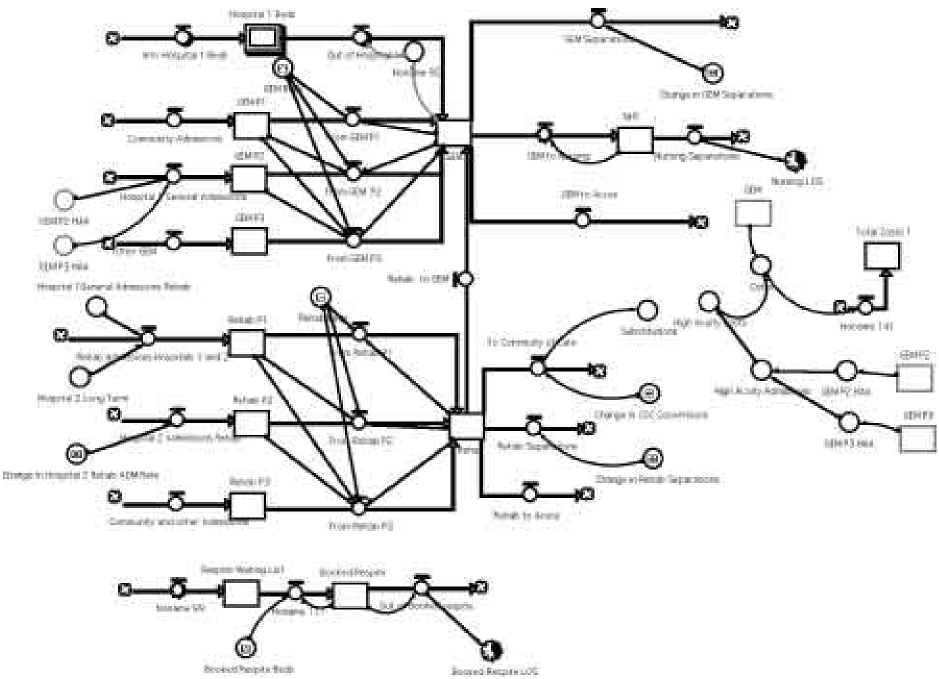
The stream of care simulation model

The stream of care simulation model was designed to test a series of scenarios based on policy options for the hospital. The model captured both structural and behavioural aspects of the hospital's operation. The structural aspects involved the configurations of bed allocations to various streams of care while the behavioural aspect involved admission decisions in the aged care hospital and waiting list decisions in the feeder hospitals. Because of feedback and feed forward impacts, the simple allocation of extra beds to either stream had significant implications for the other stream. As they attracted differential levels of funding, such outcomes needed to be well understood.

The most important aspect of the model was the simulation of the impact of the "local rules" or work practices. These local rules were the way in which policies were actually put into practice by key individuals. In this situation, the rules used by the Medical registrar for the queuing and admission of patients from various feeder hospitals were thought to have wide-spread implications for patient flow and funding. Historically, these rules had varied from registrar to registrar. Given the relatively short tenure of medical registrars, it was important to model and understand these behaviours because of their impact on the mix of patients for the hospital.

The simulation modelled three streams of care that were inflows shown on the left of Figure 3: Rehabilitation (Rehab), Geriatric Evaluation and Management (GEM) and Booked Respite. Nursing Home Type (NHT) was considered a subset of GEM. The inflows to each stream of care were modelled on historical data and the priorities set by the Registrar. For GEM the priorities were Hospital 1 Acute, Community, Acute Hospital 1 General and Other. For Rehab, the priorities were Hospital 1 General Admissions and long-term Acute from Hospital 2 short term and then Community and Other. This is modelled in Figure 3.

Figure 3: Simulation Model of Patient Flow



The outflows were modelled by destination and are shown on the right of Figure 3. GEM separations were back to the community or acute care and NHT. Rehabilitation separations were back to the community or acute care and to continuity of care (CoC). For the purpose of this paper, the behaviour of the GEM patient flow has been modelled.

Assumptions

The model was based on historical data, aggregated for June 98 to May 99, providing a total of 11 months. Average admission and separation rates were calculated. A random number generator was used to produce average figures per month. This method produced results within 1-2% of the historical data.

Local rules

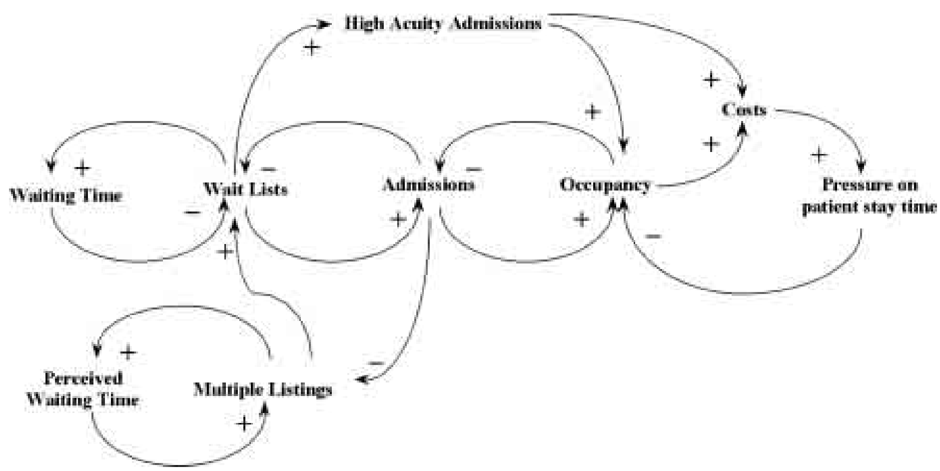
Local rule behaviour derives from theories in evolutionary biology that suggest that behaviour based on the adaptive interactions between agents are designed to make the local environment of the agent stable and predictable (Dooley, 1997; Holland, 1989, 1995; Kauffman, 1989a, 1989b, 1993; Haslett & Osborne, 2003). When successful, these behaviours can often be generalized over wide localities, with success relative to the individual agent. However, in large organisations such individual success may be detrimental to the overall well-being of the organisation.

In the situation under investigation, the local rules were specific to one individual; the medical registrar responsible for hospital admissions. As this position was rotated on a six-monthly basis, the admission policies varied considerably. Given the way the hospital was funded, the flow of patients from admissions was critical to the ability of the hospital to meet its budget.

The medical registrar at the time of the study had a policy of admitting patients from the community, namely patients under the care of private doctors, before admitting patients from feeder hospitals. This system had the effect of establishing three separate and prioritized waiting lists: private patients, patients from Hospital 1 (a major hospital in the area) and patients from other hospitals. This policy was a rational and humane option: community-based patients had nowhere to go, while patients in the feeder hospitals were in a supervised medical situation. Such behaviour has been previously documented. Kusters and Groot (1996) found that a range of factors, often situational and not explicitly stated, play a part in the admission decision process. MacLean and Garner (1987) studied the decision behaviour in a hospital system as the decision maker (physician) adapted to pressure from limited bed supply or increasing demand for hospitalisation.

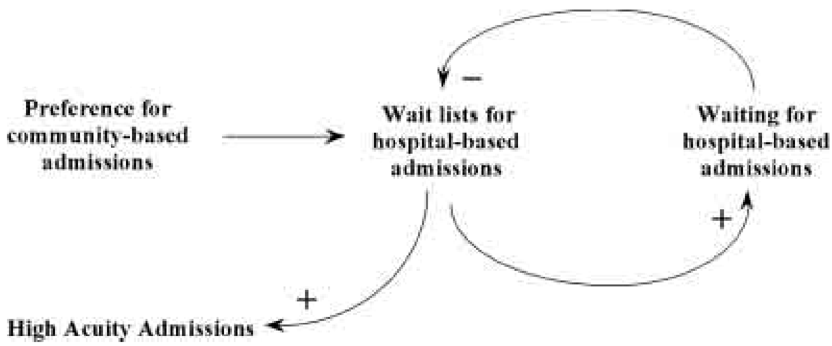
The dynamics of the situation were detrimental to the hospital because the response of feeder hospitals to the queuing priorities made it difficult to maintain patient flow and sufficiently high occupancy of the sub-acute hospital's beds. The feeder hospitals developed two local rules of their own in response to the medical registrar's local rules. The first was multiple listing of patients on waiting lists of a number of sub-acute hospitals and the second was to move borderline high acuity patients into the sub-acute hospital when waiting lists shortened. The causal loop diagram in Figure 4 shows the dynamics of the waiting lists.

Figure 4: The Impact of Wait Lists on Multiple Listings and High Acuity Listings



Hospital admissions drive waiting lists down (shown by a "-"), and short waiting lists reduce the waiting time of patients. However, as waiting lists increase waiting times also increase (shown by a "+"). When this happened, feeder hospitals would list patients on several waiting lists making it easier to place patients. However, multiple listing produced highly unstable waiting lists since patients were withdrawn as alternative care was found. The tactic of multiple listing exacerbated the volatility of the waiting lists. Figure 5 shows a more detailed representation of the dynamics of the waiting lists.

Figure 5: Impact of Registrar's Local Rule on Waiting Lists



The patients most likely to be multiple listed were those drawn from the feeder hospitals, the medical registrar's second and third priority for placement. When the feeder hospitals recognized that the waiting lists for the second and third priority patients had declined, they moved border-line high acuity patients on to the waiting lists of the sub-acute hospital. By doing this, the feeder hospitals were able to improve (i.e. decrease) their own patient length of stay. High acuity patients required a level of care above the funding levels of the sub-acute hospital. However, the sub-acute hospital was obliged to admit them to maintain occupancy rates.

The system dynamics model demonstrated the impact that the medical registrar's local rule had on the budget process of the sub-acute hospital. Figure 3 compares the cost of using the medical registrar's prioritized waiting lists with a single unprioritised waiting list. The unprioritised list maintains waiting lists at a level that effectively short-circuits the feeder hospital second local rule of moving high acuity patients on to the wait list of the sub-acute hospital.

The admission of these patients was driven by the fact that the sub-acute hospital was funded only for occupied beds. However, if patient costs rose, as a result of a borderline high acuity patient being in a bed funded at sub-acute rates, the sub-acute hospital was not reimbursed for those additional costs. The sub-acute hospital needed to maintain the right balance between bed occupancy and patient acuity to meet its budget. It was therefore of great importance to maintain occupancy at, or very close to, 100% of the agreed and budgeted level and to contain costs per patient to a point equal to, or lower than, the budget cost for a sub-acute patient. Figure 6 shows the cumulative variance from budget if the local rule was followed over the unprioritised policy for a year.

Figure 6: Cost variation over a year

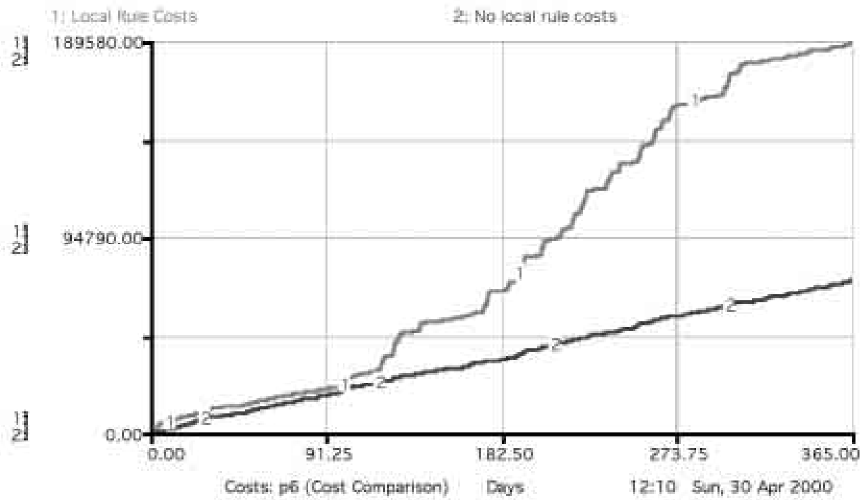


Table 1 shows that the cost of the local rule was $133,000, a 6% overrun on budget whereas the cost without the local rule was 3% under budget.

Table 1: Performance against budget of local rule.

Budget	Total Cost	Against budget	
Local rule	2,367,390	2,431,640	+ 6%
No local rule	2,367,390	2,286,760	- 3%

Conclusion

The simulation demonstrated the impact of the local rule used by the medical registrar and its potential to cause a budget overrun. Had the local rule not been used, the hospital's budgetary situation would have been stronger. It is important to stress that this model demonstrates the potential effect of the application of the local rule for a year. It does not model the compensating actions that could be taken by hospital management, such as closing beds or targeting fee paying patients, to keep the budget on track. These actions would effectively mask the impact of the local rules. This serves to highlight the importance of simulation of administrative and management systems: it allows the isolation and identification of cost drivers in the system.

The medical registrar was exercising professional judgement in the matter waiting lists. The impact of these decisions arose from a subtle interaction of factors beyond the registrar's, or indeed the hospital's control. However, as the simulation suggests that this single decision on the matter of admission priorities would cause an annual 6% budget overrun, it is extremely important for hospital administrators to understand these decision processes. One of the key issues for the effective running of hospitals is maintaining a balance between professional judgments of medical practitioners and the costs of these judgments.

The local rule used by the medical registrar was relatively transient, as the position was rotated on a six-monthly basis. The systemic impact of any new local rule put in place with the next medical registrar was therefore, unknown. However, it was clear that the impact could be wide-spread and systemic, particularly in relation to the feeder hospitals responses to the medical registrar's local rule. The challenge for the hospital administration is to be aware of, and manage, these local rules, particularly those generated in the domain of the professional judgement of medical practitioners. This remains an area where hospital administrators venture with justifiable caution.

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