Planning for transition care

Angela Crombie, Jenni Ham, Kevin Masman and Terence M Mills

Abstract

The Australian Government introduced the National Transition Care Program in the 2004–2005 Federal Budget. This program is designed to assist elderly patients who have completed a stay in hospital to move from the hospital to their homes or other suitable accommodation. In planning for transition care services, managers are faced with the question, "How many places should be allocated to transition care in our facility?" This case study offers an approach to this question based on queueing theory.

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What is known about the topic?

Methods from queueing theory have an established place in capacity planning in health care. Queueing theory can improve our understanding of the dynamics of patient flow in areas where there is concern about excessive waiting times and other symptoms of congestion in the system.

What does this paper add?

This case study applies queueing theory to a capacity planning problem in aged care. As a result of a recent Australian Government initiative, hospitals are developing plans for transition care for elderly patients. This case study describes how one hospital used queueing theory to plan for the introduction of this service. The authors address the practical problem of building the model when the hospital does not have an established transition care unit as a source of data.

What are the implications for practitioners?

Health care managers can use this worked example when planning for the introduction of a transition care program. Such methods may strengthen submissions to funding authorities for new transition care places. Furthermore, the approach presented in this paper could be readily adapted to other problems in capacity planning.

IN THE 2004–05 Federal Budget, the Australian Government launched a national Transition Care Program (TCP). Transition care was defined broadly as follows:[1] "Transition Care provides short-term support and active management for older people at the interface of the acute/sub-acute and aged care sectors." This national program was implemented through the joint efforts of the Australian Government and state and territory governments. In Victoria, the TCP commenced in 2006 and brought together elements of "interim care" and similar service models under a single program. Details concerning the program can be found in the published guidelines.[1]

The essence of the program is that elderly hospital patients who have been discharged from the acute or sub-acute sector of a hospital may benefit from a short stay in a transition care bed before they return to their home or aged care home or other suitable accommodation. Thus, transition care facilities play a role in the interaction between acute and sub-acute sectors of a hospital.[2] The transition care beds could be either in a residential setting or in a community setting.

Health care facilities may be eligible to apply for government funds to support transition care places. A key problem for managers is to estimate the number of places required for the program in the facility. There are many factors for the manager to consider: for example, demand, occupancy, physical space, staffing, and policy issues will be relevant.

The aim of this case study is to describe how ideas from queueing theory were used at one

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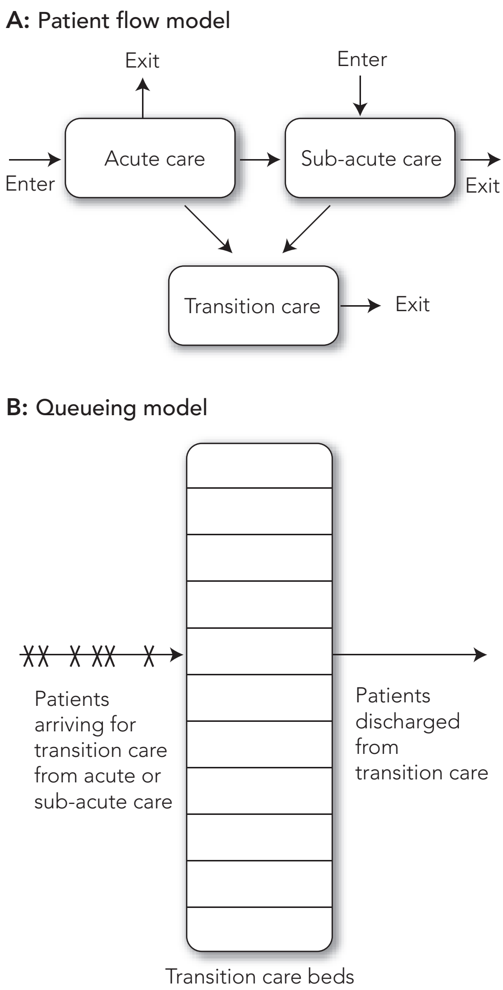
1 Models for transition care



hospital to arrive at such estimates after considering demand and occupancy factors. Other factors are not considered in this paper.

Queueing model

Queueing theory is a branch of knowledge concerned with modelling queues and developing a better understanding of the associated congestion. The theory has been applied in health care planning for more than 50 years, often in planning for emergency services.[3,4] In this section, we show how a classical queueing model can be applied to planning for transition care.

The figure in Box 1, A describes how patients enter and exit transition care. Note that patients enter transition care only from the acute or sub-acute sectors of the hospital. It is likely that most patients in transition care would come from the sub-acute sector.

The figure in Box 1, B depicts patient flow as a queueing model. Although there are two sources of patients (acute and sub-acute), we do not distinguish between the two sources. The problem is to estimate the number of beds that are required to handle the total flow of patients. This estimation problem can be addressed using ideas from queueing theory.

The following concepts and assumptions will be necessary for the subsequent calculations. The first assumption concerns the pattern of demand for places in the transition care unit. The number of new patients that become eligible each week for transition care should follow a Poisson distribution, with mean denoted by m. This assumption is quite reasonable in any facility where there is a large pool of patients in acute and sub-acute care and, in any week, only a small proportion of those patients will become eligible for transition care. See Kerr et al,[5] p. 210 for a mathematical justification.

The second assumption concerns the patterns of length of stay in the transition care unit. The calculations below will hold for *any* distribution of length of stay in transition care. This remarkable mathematical fact makes the methods in this paper transferable to other situations. Average length of stay (*ALOS*), measured in weeks, will denote the average length of stay in transition care. See Gross and Harris,[6] p. 245 for mathematical details.

Third, the system must have settled down and be in equilibrium. Thus the results below predict what will happen in the long term rather than what will happen immediately. How long one has to wait until the system can be said to be in equilibrium will vary over different facilities. The aim of this calculation is to predict what will happen at that time.

2 Occupancy probabilities for transition care*

k	(Probability that occupancy=k)%	(Probability that occupancy<k)%
0	0.00	0.00
1	0.01	0.00
2	0.07	0.01
3	0.28	0.09
4	0.79	0.36
5	1.80	1.15
6	3.41	2.95
7	5.56	6.36
8	7.92	11.94
9	10.03	19.82
10	11.44	29.87

* Where $m = 1.2$ patients/week and $ALOS = 9.5$ weeks.

If we had unlimited capacity of transition care beds, then, in the long run, the number of patients in transition care (the occupancy) would follow a Poisson distribution with mean $m \times ALOS$. This is a result from queueing theory[6] (p. 245).

Thus, knowing only m and $ALOS$, we can calculate the long-term probabilities associated with different occupancies. This is a very useful result for capacity planning.

An example is given in Box 2. In this example, $m = 1.2$ patients; that is, on average, 1.2 patients in acute or sub-acute care will become eligible for transition care each week. Also, we have assumed that $ALOS = 9.5$ weeks; that is, the average length of stay of patients in transition care will be 9.5 weeks. Note that there are some rounding errors in this table since probabilities have been calculated to many decimal places but reported only to two decimal places.

Therefore, in the long run, the number of patients in transition care (occupancy) will follow a Poisson distribution with mean $= 1.2 \times 9.5 = 11.4$. The Poisson probabilities in Box 2 were calculated easily by using a spreadsheet.

According to the example in Box 2, the probability that the occupancy is less than 7 is 6.36%. This means that on 6.36% of days, there will be less than 7 patients in transition care — if we had unlimited capacity! Therefore, if the hospital had allocated 7 beds to transition care, then, in the long run, there would be some empty beds on 6.36% of days, or about 1 day in 15.

On the other hand, if the hospital had allocated 9 beds to transition care, then, in the long run, there would be some empty beds on 19.82% of days, or about 1 day in 5.

So the results of this calculation allow health care decision makers to assess the likelihood of different occupancy levels in the proposed transition care beds. They can explore different scenarios by varying m and $ALOS$ and hence conducting a “What-if?” analysis.

Estimating the parameters

The key to the calculations in the previous section is to have estimates of the two parameters m and $ALOS$. This section describes how these parameters may be estimated when there has been no history of transition care in the hospital, and hence no data on which to base estimates.

First we consider ways of estimating m. Recall that m is the average number of new patients that become eligible each week for transition care. The Patient Flow Coordinator in the hospital will have a sound overview of the average proportion of patients from acute and sub-acute care who may be eligible in a week for moving to transition care. Nurse Unit Managers will have a more detailed view of the flow from their own units. So, by seeking advice from these people, one may get some idea of reasonable values for m.

Now we consider estimating $ALOS$ in transition care. The government guidelines suggest that length of stay in transition care should not exceed 12 weeks for residential units and 8 weeks for community units. However, the guidelines suggest that these limits may be exceeded in special cases. These guidelines give us a guide to $ALOS$ in each setting. Checking with other facilities that have adopted transition care will offer more information.

We recommend that the manager finds intervals that are likely to contain the parameters. For example, after some investigations as suggested above, the manager may feel that m is likely to be between 1.1 and 1.8 and that *ALOS* may lie between 8 weeks and 12 weeks. Then the manager can explore the occupancy distribution using combinations of values from these two intervals.

Conclusions

This case study describes the approach used by a hospital to estimate the long-term occupancy patterns of transition care beds. There are several benefits of the method presented in this paper. The approach has a scientific basis and is simple. It gives the manager a guide to the likely occupancies of transition care beds under different scenarios. The very exercise of estimating the two parameters in the model will assist the manager to focus on key aspects of the proposed unit. Finally, the method can be transferred and applied to capacity planning for other units such as a short stay unit in the emergency department.

The main limitation of the method is that it provides forecasts of long-term, rather than short-term, occupancy patterns. Another limitation is that we have considered only demand and occupancy factors. Other factors mentioned above have not been considered. The model discussed in this paper could be enhanced by considering separate queues for acute and sub-acute patients. However, the purpose of the article is to offer managers a practical approach by which they can assess the potential of their organisation for introducing a transition care unit.

Competing interests

The authors declare that they have no competing interests.

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