

## Workforce Modelling in Healthcare

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**Abstract** - The National Health Service is Europe's largest employer, with over 70 different professions. A simulation model designed to forecast workforce needs in the acute hospital setting is described. A modelling approach for taking the experience and ideas from the acute setting to intermediate care is proposed, to encompass the whole system and the individual parts. This will enable patient needs and the most effective workforce skill mix for nurses and therapists to be calculated.

**Keywords** - Workforce, Healthcare, Simulation

### I. INTRODUCTION

The National Health Service (NHS) is Europe's largest employer with around one million employees in over 70 different professions. It may be considered as a large-scale, complex organisation where day-to-day operations are influenced by stochastic conditions such as variability in patient demand and resource needs.

Historically, workforce has been particularly difficult to plan and thus staffing has always been, and still is a particular area of concern. Many failed attempts to plan are documented in [Rivett, 1998]

More recently, the choice of careers (particularly with regard to nurses) within the NHS has grown, as new roles are developed in a bid to try and keep the current employees within the NHS and to encourage others to join. This is partly in response to the changes in perceptions of nursing as a career by young people, as shown in [Hemsley-Brown & Foskett, 1999].

The healthcare needs of the UK population are ever changing and ever more demanding. Intermediate care has been developed to try to meet the demands of reduced numbers of acute hospital beds and an aging population. Within the NHS Plan [Department of Health, 2000], Intermediate Care has been identified as a key area. Health and social care services need to develop in order to be able to respond to the needs of the people.

### II. INTERMEDIATE CARE REVIEW AND LIMITATION OF CURRENT WORK

Several studies explore the different outcomes for patients cared for in their own home compared to a hospital setting. A detailed cost analysis can be found in [Coast et al., 1998]. Three different Hospital-at-home studies are compared in [Corrado, 2001] and it is found that although overall patient Length of Stay may increase, acute hospital bed days are reduced and patient satisfaction is greater for those cared for at home.

The ICON (Intermediate Care, Organisation and Normalisation) Project [Carpenter et al., 2003] has created a Discrete Event Simulation (DES) model of the Intermediate Care services in Kent, both individually, and as a whole, to examine the entry criteria. Experiments were carried out which involved increasing the number of beds (for inpatient services) and the number of workforce for home based services to find out the optimal capacity for the current flow of patients through the system.

#### A. Acute Hospital

PROMPT (Patient Resource Operational Management Planning Tool), a Three Phase Simulation model was developed by Harper [Harper, 2002] to model the flow of patients through a hospital. By varying the numbers and types of patients, the capacity of the hospital can be analysed. The model was developed in conjunction with the Royal Berkshire and Battle Hospitals Trust and is in regular use as part of the trust's business planning cycle and during service development planning and scenarios evaluation. [Dale et al., 2003]

PROMPT has recently been extended to include workforce methods. Methods being implemented are the Occupied Bed and the Acuity-Dependency methods for calculating workforce needs, which are described briefly below and in more detail in [Hurst, 2002].

#### B. Workforce Calculation

There are five main approaches to nursing workforce planning which have been used historically. These are Professional Judgement, Occupied Bed, Acuity-Dependency, Timed task/activity, and Regression analysis. The Occupied Bed and the Acuity-Dependency methods have been implemented in Prompt.

*B1. Nurses per Occupied Bed:* A ratio of nurses per occupied bed is used to calculate the number of Whole

Time Equivalent nurses to employ. This is directly comparable to the national audit data.

*B2. Dependency-Activity-Quality (Acuity-Quality):* In the large majority of cases, each patient's dependency will change during their length of stay. This method allows a ratio of each type of workforce to be defined for each of the possible patient dependency states. The workforce needs for each shift are then calculated at each time step in the simulation and can be used to estimate an overall number of Whole Time Equivalent nurses to employ.

*C. Model Details*

Prompt has been written in Visual Basic, incorporating a user friendly windows interface. The user has to define all parts of the hospital and can choose which workforce methods to use when running a simulation. Flexibility has been incorporated, such that the model can be used to evaluate scenarios for an individual ward, group of wards or an entire hospital. An overview of the inputs and outputs of the model can be seen in Figure 1.

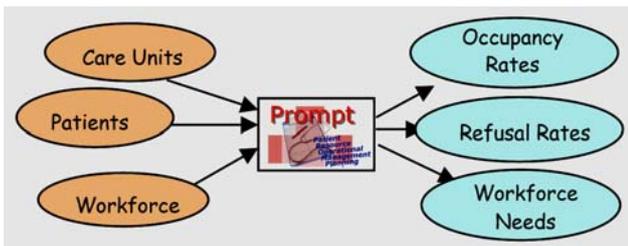


Figure 1. An overview of the Inputs and Outputs of PROMPT

*D. Data Acquisition*

As with many projects, particularly those concerning healthcare, data acquisition has been the main difficulty. In order to ensure that bad nursing practice is not advocated, dependency ratios have had to be defined, working with (in most cases) the lead sister for each specialty.

Patients are grouped into clinically meaningful and dependency similar groups, mainly by procedure or diagnostic code. The data for this was obtained from the hospital database. A distribution can then be fitted to the Length of Stay for each patient group.

III. A PROPOSED NEW SYSTEM

*A. Key Aims:*

Questions which the research aims to answer are:

- What is the most effective way to deploy current Intermediate Care workforce to deliver to the presenting patient needs?

- What is the common set of skills required by all staff to optimise contact time with patients?
- What will the future workforce requirements for Intermediate Care be?

*B. Intermediate Care*

The experience and ideas from the acute hospital work are being developed for the Intermediate Care setting. Intermediate care presents its own idiosyncrasies not least because of the variety of methods of delivering care to the patients.

*C. Definition*

Many different definitions of Intermediate Care exist and many different ways of implementing Intermediate Care are being developed and are being, or have been, implemented across the country. The definition used for this study is the one given by the National Service Framework for Older People [Department of Health, 2001]:

“A short period (normally no longer than six weeks) of intensive rehabilitation and treatment to enable patients to return home following hospitalisation, or to prevent admission to long term residential care; or intensive care at home to prevent unnecessary hospital admission.”

Intermediate Care can be delivered to the patient in a number of places:

- In the patient's home;
- At a Day Hospital;
- In a non-acute hospital setting.

Intermediate Care is delivered to the patient by a number of types of workforce across both Health and Social Care. The main ones are:

- Nurses;
- Occupational Therapists;
- Physiotherapists;
- Social Workers;
- Rehabilitation Assistants.

*D. Overview of Proposed Research*

A Modelling approach is being developed to combine the following:

- System Dynamics Model to describe demographic changes.
- Discrete Event Simulation Model to model detail of workforce needs within Intermediate Care.
- Mathematical Programming to allow cost analysis of workforce requirements.

Current service provision tends to be based around workforce availability rather than patient need. Our aim is to aid in an understanding of patient need and thereby discover the best workforce skill mix for nurses and therapists. This will then be used to influence training of current staff and future staff with a view to maximising the time spent with the patient.

An overview of the modelling approach can be seen in Figure 2.

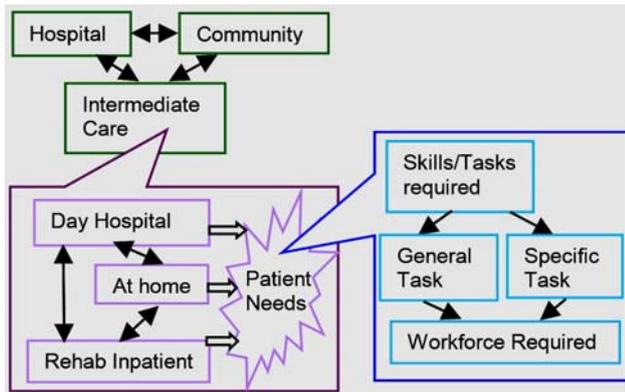


Figure 2. Overview of Modelling Approach

#### E. Data Acquisition

Data for each service is held separately and often in a different format. This is mostly in the form of handwritten logbooks and notes. Thus access to the data presents difficulties and ethics approval is needed if someone from outside the service wishes to look at data from which it is possible to identify the patient.

#### IV. CONCLUSION AND FUTURE WORK

We described a simulation model designed to forecast workforce needs in acute hospital settings and proposed a modelling approach for taking the experience and ideas from acute settings to intermediate care, this would encompass the whole system and the individual parts. There are plans to incorporate doctors and allied health professionals into the model and funding is being acquired to do this. It is anticipated that these ratios will not necessarily be ward or bed based and that geographical locations of patients within the hospital may need to be considered.

#### ACKNOWLEDGEMENTS

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