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Duty Rostering in a Primary Nursing Environment

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Presentation of the Award

The Dame Phyllis Friend Award was presented by Maureen Scholes who was one of the first computer project nurses in 1968. She was a founder member of the Nursing Specialist Group (NSG) and of the nursing group within IMIA.

Maureen recalled her work at The London Hospital thirty years ago when she was in charge of nurse allocation for over 1000 students. The London undertook the first NHS computerised nurse manpower system project in 1968.

Dame Phyllis was Matron at The London before becoming Chief Nursing Officer at the Department of Health. She showed great vision; bringing together the computer project nurses for regular meetings, this laid the foundations for NSG. The award was established in 1989 to recognise her contribution and to encourage members of NSG to describe their ideas and work.

Introduction

This article provides an overview of a prototype computer-based, hospital ward duty-planning system. The system builds on previous work in this field by incorporating the concept of Primary Nursing (1,2) and it supersedes existing generic systems, which traditionally use a cyclical approach, by incorporating domain-specific expert knowledge.

The case for more effective duty planning is well documented.(3,4,5,6). The potential benefits are numerous and manifest themselves in quantitative ways, such as the optimal deployment of a finite number of staff, and in qualitative ways, such as increased quality of patient care.

Current approaches to the problem are unsatisfactory for a number of reasons. The traditional manual approach (7), based largely on trial-and-error, is very flexible but is
labour intensive, which generally results in the production of sub-optimal schedules. Automated approaches(8) either tend to oversimplify the problem or, in trying to address all of the problems inherent in any conceivable environment, their complexity makes them impractical and prohibitively expensive.

The prototype system is designed with flexibility in mind but is also strongly tailored to the needs of a particular environment. It is low-cost in terms of development, use, and maintenance, but is nevertheless effective in that it produces levels of coverage and shift pattern quality which exceed those of existing manual approaches. The system is PC-based and is driven by menus and simple command lines.

Conceptually, the system consists of two sub-systems.

First sub-system

The first concerns ward policy decisions and may be seen as largely responsible for system administration.

The facilities provided include:

- allowing for a variety of relevant ward information to be displayed, such as the previous week's plan
- allowing for the amendment and augmentation of staff member details, such as name, grade, team number etc;
- allowing for the definition of minimum staffing numbers both wardwise and teamwise for all grade levels i.e. managerial (Grade E and above), qualified (Grade D and above) and all other grades (Grade A to C, students etc);
- allowing for the definition of a small set of high-quality standard duties which are then manipulated by the system, with no loss in quality, to provide a much larger set for use in duty planning;
- allowing for the definition of recurrent input in the form of requests for, and restrictions on, particular duties, for each member of staff.

Second sub-system

The second sub-system uses the persistent administrative information to perform the actual allocation of duties.

The process begins with the creation of an initial schedule. Duties are defined by the system operator, for all staff members who work a fixed shift pattern (for reasons of individual preference or due to Unit coverage requirements), whilst the system places duties of a maximum quality for those staff members who work variable patterns. These variable duties are selected from the set of user-defined standard duties. The quality of duties is maximised by selecting those duties with the lowest aversion weighting. Aversion weightings accrue as certain user-defined constraints are violated, such as the inability to meet requests.
From this initial schedule, the system strives to achieve ward coverage for all grade levels, whilst trying to maintain the highest possible level of quality. This involves replacing appropriate initial duties with duties of a lower quality, but which afford a higher level of ward coverage in terms of a greater total number of covered shifts. This process continues until either ward coverage is achieved or a predetermined effort is expended.

A similar process is then carried out for each individual team, the difference being that duties are only replaced if they afford a higher level of team coverage and at the same time do not cause a decrease in the existing level of ward coverage.

Final process

If, at this stage, the ward is still not covered, the schedule is further optimised. This final process involves the selective replacement of shifts which are undercovered with those which are overcovered, and takes the schedule to a coverage solution. In the event that actual staff numbers cannot provide minimal coverage for the ward, the predefined coverage levels are temporarily decremented, which provides a better distribution of limited numbers of staff throughout the week. As ward coverage must take priority over coverage for individual teams, the system is organised in such a way that allocation is performed for the entire ward, for which the minimum level of actual staffing levels is fixed, before considering individual teams. Similarly, as it is a requirement that the ward is minimally covered for higher grades of staff, managerial grades are assigned duties before lower grades, who effectively fill any remaining coverage gaps.

The system in operation

After three months of trials, Ward Managers have found the prototype system easy to use and well suited to their particular needs. It has coped well with any planning problems encountered thus far and compares very favourably with the existing manual approach. Examples of a manually produced duty-plan and a corresponding automatically produced, duty-plan are given in figures 1 and 2 respectively. Figure 3, summarises the overall performance of both approaches with respect to these examples.

**Figure 1 Manually produced duty-plan**

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In terms of coverage and quality, both approaches yield very similar results (the automated approach actually provides a slightly better solution). However, this similarity ends when planning time is examined, with the automated approach requiring less than 5% of the time needed by the manual approach to come to a solution. Because of these factors, the prototype system is now in regular use.

**Conclusion**

As a prototype, in the particular environment for which it was designed, the new system is highly successful.
To take the system into a more generic, "off-the-shelf" field will be a trivial task. Due to its flexibility, the basic structure of the system is suitable for any ward duty planning environment. The simple adaptation of shift pattern constraints into a library format will allow individual wards to design and amend their own profiles, and the addition of, for example a WIMPS interface will increase sales image and usability. This will give the system a greater ability to fill a gap in the duty planning systems market i.e. the great need for a low-cost, effective and usable system which may be tailored to the needs of any particular environment.

References


Glossary

IMIA - International Medical Informatics Association.

PC-based abb. personal-computer.

Grades - A clinical grading system, based on the span of management and depth of knowledge required in a post is used for salaries. Grade A is an unqualified nursing auxiliary. Grade G is a senior sister/charge nurse.

WIMPS - Windows Icons Menus Pointer environment giver, access without using a keyboard by moving a mouse, which moves a pointer over icons displayed on the screen. Icons - symbols displayed on screen as a method of offering a range of choices