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A Decision Support System for Nursing Care in Thailand

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ABSTRACT

Computers have been installed in a number of hospitals in Thailand and one of the computer applications in hospitals highly necessary and desirable is in the area of nursing care. This paper presents a decision support system for nursing care plan and nurse scheduling. In the part on nursing care plan, nursing activities and nursing care together with the weighted values and criteria to determine required care contributions are established. Activities performed on each individual patient, patient's needs and patient's conditions are entered into the system as they occur. The computerized decision support system then makes an analysis and proposes adjustments based on the specified criteria. The relationship between workload and number of nurses actually worked on each shift is determined in the manner to keep workload among nursing wards as well balanced as possible. In the part on nurse scheduling, the criteria-based information as well as rules for working shift assignments are stored in the system. Statistical information together with the most suitable and practical schedules are produced for the nurse supervisors. Formulae and criteria to determine the best-fit-best-fair schedule are developed. The decision support system presented in this paper has been written in COBOL on Perkin-Elmer which had later been renamed Concurrent computer and installed at three private hospitals in Thailand and found to be of benefits to nurses, nurse supervisors and the hospitals.

1. INTRODUCTION

A few definitions of the term "nursing" have been given. According to Henderson [4], nursing is to "assist the individual, sick or well, in the performance of those activities contributing to health or its recovery (or to peaceful death) that he would perform unaided if he had the strength, will, or knowledge, and to do this in such a way to help him gain independence as rapidly as possible". According to the American Nurses" Association [1], "nursing is the diagnosis and treatment of human responses to actual or potential health problems".

No matter which of the above two definitions are used, nursing is unquestionably a very necessary and important part of any hospital. Computerized hospital information systems (HIS) were introduced in the United States in the mid-1960's [5,6,7] but in Thailand only in the 1980's [2,3]. In that sense, general computerization in Thai hospitals may be said to be more than ten years behide that in the United States. However, as far as specialized computer-related medical equipments are concerned, some hospital in Thailand are as modern as in the United States and any other countries in the world.

The nursing situations in Thailand are different from those in the United States. For example, due to shortage of nurses, some of them take two full-time jobs and hospitals have to allow them to use their preference in choosing their own working shifts.

Nursing information systems (NIS) are slow to start in Thailand and most are locally developed. This paper presents a decision support systems for nursing care plan and nurse scheduling. The second author together with her team at Loxley (Bangkok) Limited company has been working on analysis, design and implementation of the system since 1985 and the first author has been her academic advisor. The system was written in COBOL for the Perkin-Elmer computer which was later renamed Concurent computer. It was first installed at Samitivej hospital which is a private hospital in Bangkok with 250 beds. After successfully tested at Samitivej, it was later adopted in a few more private hospitals such as Bangkok hospital with 300 beds and St.Louis hospital also with 300 beds. The system has undergone five modifications to satisfy user's changing requirements and additional user's requirements will be incorporated in future modifications.

2. PARAMETERS AND CRITERIA

The decision support system for nursing care requires knowledge on basic nursing activities with corresponding weighted values and criteria which may be changed by management from times to times.

2.1 TIME INDEX. Weighted values related to shift is required due to the assumption that contribution required in the same activity and patient condition is based on time.

In general practice, Time Index is assigned to be 1.0 for Day Shift (08.00-15.59), 0.8 for Evening Shift (16.00-24.00), and 0.6 for Night Shift (00.01-07.59).

2.2 STAFF CONTRIBUTION FACTOR. It is assumed that different types of nursing staff, namely, G.N. for graduate nurse, P.N. for practical nurse, and Clerk for ward clerk, contribute different degree of service. Generally, the contribution factor 200, 150 and 100 are assigned for individual G.N., P.N., and Clerk respectively.

2.3 PATIENT CLASSIFICATION. Each patient is classified according to the total contribution required in term of total scores. The classification ranges may differ from hospitals to hospitals and an example is shown in Table 1.

Table 1 : Patient Classification

TOTAL SCORES	CLASS
0 - 37	A
38 - 55	B
56 - 70	C
71 - 83	D
84 Up	E

2.4 WORKLOAD DETERMINATION CRITERIA. Criteria ranges to justify workload for each ward are shown as an example in Table 2.

Table 2: Workload Ranges

WORK INDEX	WORKLOAD
0 - 0.49	Minimum
0.50 - 0.79	Light
0.80 - 1.19	Average
1.20 - 1.49	Heavy
1.50 Up	Maximum

3. NURSING CARE PLAN.

In nursing care plan, the Nurse-In-Charge is required to review/report on patient's status and activities required for each patient according to the following conditions:

(1) When new admission or transfer patient is acknowledged.
(2) When doctor's order for particular patient is changed.
(3) Upon shift change review.

Upon the confirmation of each patient's activities review, total scores are re-calculated and captured into the system. As requested, the program will determine workload and justify work index pertain-

ing to each nursing ward using the formulae in Sections 3.1 and 3.2 below:

3.1 TOTAL CONTRIBUTION. The formula for total contribution is

$$T_i = (G_i * X) + (P_i * Y) + (C_i * Z)$$

where T_i = Total staff contribution for each ward

G_i = Number of G.N. signed on each shift each ward

X = G.N. contribution factor

P_i = Number of P.N. signed on each shift each ward

Y = P.N. contribution factor

C_i = Number of clerks signed on each shift each ward

Z = Clerk contribution factor

As an example, suppose in Ward 3A, at the request time there are 5 graduate nurses, 1 practical nurse, and 5 clerks signed on, then

$$T = (5 * 200) + (1 * 150) + (3 * 100) = 1{,}450$$

Thus the total staff contribution of Ward 3A is 1,450.

3.2 WORK INDEX. The work index may be computed by use of:

$$W_i = (S_i * I) / T_i$$

where W_i = Work index of each ward

S_i = Total patient scores of each ward

I = Time index

T_i = Total contribution of each ward

4. NURSE SCHEDULING.

The nurse scheduling part of the decision support system requires the knowledge of shift pattern, working-day pattern, and special request.

4.1 SHIFT PATTERN. There are three different types of working shift pattern:

(1) Rotation Basis. In this pattern, the day, evening, and night shifts will be distributed fairly among other staff within the unit

(2) Fixed-Shift Basis. In this pattern, it may be day-only, evening-only, or night-only.

(3) Exceptional Basis. In this pattern, the staff can request to be rotational but exempted from certain shifts, e.g. day and evening but not night, or evening and night but not day, etc.

4.2 WORKING DAY PATTERN. There are two types of working-day patterns:

(1) Two days-off per week (5/2)

(2) One day-off per week (6/1)

4.3 STAFF CONTRIBUTION. Sample criteria are:

(1) The number of regular working shifts for each 5/2 staff equals the number of week days (Monday to Friday) excluding statutory holidays.

(2) Four additional working shifts per month are added to make the total working shifts for 6/1 staff.

4.4 MINIMUM REQUIREMENT. It may be agreed that the standard minimum requirement for the scheduling unit is mandatory but the unit head can review information pertaining to scheduling generation prior to the actual run.

4.5 SPECIAL REQUESTS. The types of request may be rejectabale and nonrejectable. The management have to decide on exceptable special requests such as maternity leave, training leave, personal leave and vacation.

4.6 TOTAL WORKING SHIFT REQUIRED. At the beginning of the process, the system will determine the total number of working shifts required for the month being scheduled. For example, the total number of working shifts minimumly required for G.N. staff in March 1993 is 186 (based on actual calendar days).

In case of labour shortage, total required working shifts may exceed total regular contribution. In that case, Overtime Shifts are to be considered.

4.7 SHIFT ASSIGNMENT CRITERIA. To prevent human fatique, the scheduling will not allow 6 consecutive working days. The assignment will be processed day by day starting from the 1st of the month. The shift-off (special request) on the scheduling date will be marked in the schedule. In case that the system cannot assign staff to meet the minimum requirement, the system will reject some of rejectable request on random basis. Before the system begins to mark working shift for each staff, some concerns are needed to be considered to make scheduling more practical and reasonable:

- Any staff who has been assigned 3 consecutive Evening or Night Shifts is entitled for one day-off. This rule will be assigned only for staff in rotation and exceptional-shift categories.

- A day-off shift will be given to staff whose previous shift is Night.

- For staff who has been working on 6 evening or night shifts continuously, 2 consecutive days-off must be assigned. This is because it is observed that working during odd hours (Evening/Night) is likely to cause physical and mental fatigue and shifting of sleeping hours causes some dis-organization of body clock.

- If the scheduling day is Sunday, staff who has been given previous day (Saturday) off will not be assigned in order to allow staff on rotational shift basis to be able to spend the week-end with her family.

4.8 WORKING SHIFT ALLOCATION. In day shift assignment, each staff available for the scheduling will be given an "Assignment Value" determined by:

$$A_i = d_i / D_i$$

where A_i = Assignment Value for individual staff

d_i = Number of Day Shifts previously assigned in the scheduling month

D_i = Total number of Day Shifts individual staff is expected to contribute

There are other concerns that effects the quality of the scheduling process:

(1) As the hospital encourages staff to work at least on 3 consecutive shifts of the same type, staff who has been assigned "Day" on the previous shift should be given preference to be assigned "Day" again provided that the assigning slot is not already marked.

(2) The working shifts will be assigned by the ascending order of the Assignment Values.

(3) If the system cannot satisfy the minimum requirement, it will put the rejectable-request staff back onto the list and repeat the assignment process.

(4) Eventually, if there is not enough staff from the rejectable-request list to satisfy the minimum requirement criteria, overtime shift will optionally be assigned. Alternately, additional staff from outside may be used to fix the situation temporarily.

The process to assign Evening and Night Shifts can be carried out in a similar manner to the case of Day Shift Assignment.

5. CONCLUDING REMARKS

The decision support system for nursing care presented in this paper has been analyzed, designed and implemented specifically for private hospitals in Thailand. The system was written in COBOL and installed at Samitivej hospital and later adopted in two more private hospitals.

Five modifications have been made to suit the users' additional requirements. One modification is being considered to integrate the nursing care plan and nurse scheduling system with the recruiting system. More modifications will probably have to be made to suit the users' ever changing requirements.

Although the users at Samitivej hospital as well as at the other two hospitals are relatively satisfied with the usefulness of thesystem,they would welcome any improvement. Therefore, expert system technolgy as well as fuzzy logic and fuzzy database and neural network have been considered and will probably be included later in order to enhance the performance of the decision support system.

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