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Effectiveness of Quality Nurse Scheduling

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Abstract

The aim of this paper is to operationalize the concept of nursing schedule quality in such a way that it can cope with the nature of nursing schedule quality. This operationalization describes, the concept of nursing schedule quality needs to be analyzed in such a way that all views on this quality are taken into account. This type of an analysis results in a conceptual model of nursing schedule quality. Then it concerns the operationalization of this conceptual model into a formal model of nursing schedule quality. This type of formal model enables the measurement of this quality. Finally the application of this formal model in order to support the task of nurse scheduling.

1. Nursing Management

Nursing management consists of the performance of the leadership functions of governance and decision-making within organizations employing nurses. It includes processes common to all management like planning, organizing, staffing, directing and controlling. Health care organizations are mostly divided into a number of nursing units. The director of a nursing unit is called a nurse administrator, also verify Kedzierski & Vlemmix, 1992. One of the most important functions of the nurse administrators is to gear the deployment of nurses to the patients admitted to the nursing unit. This section discusses the characteristics energy medicine originally developed by Lloyd and his colleagues. The next subsections describe principle and suggestion related to this energy medicine , its levels of planning, definitions, and consequences.

1.1 Principle and suggestion of nurses and patients

The numbers of nurses working at a nursing unit is a result of the process of nursing staff planning, mostly referred to as staffing. The staffing policy controls this process of staffing by Louwies, 1984. This staffing policy determines, for instance, the ratios per nurse category *e.g.* registered nurses, licensed practical nurses and nursing assistants, at each nursing unit. On the other hand, the numbers of patients admitted to a nursing unit is a result of the process of admission planning by De Vries, 1984. The admission policy controls this process of admission planning by Hogewind, 1988, Kusters, 1988, Lettink, 1990. This admission policy determines, for instance, the types of patients admitted to each nursing unit. Nursing schedules attune the nurses working at the nursing unit to the patients admitted to this nursing unit. The process of nurse scheduling determines the features of these nursing schedules by Diekema, 1984. The nurse scheduling policy controls this process of nurse scheduling by Kedzierski, 1984. This nurse scheduling policy determines, for instance, the procedure for assigning short time days De Vries, 1984a).

1.2 Different stages of planning

Strategic, tactical, and operational planning are the three types of planning shown that is nursing staff planning, admission planning and nursing schedule planning are divided on the basis of these three levels . Strategic nursing staff planning involves the determination of the types of personnel to be employed on a permanent basis. Tactical nursing staff planning involves determining the numbers of personnel assigned to a nursing unit. These tactical nursing staffs' planning mostly involves a period of about a year. This tactical staffing is mostly referred to as the 'staffing problem'. Operational nursing staff planning involves the 'allocation' of the work tasks to the nursing personnel. Operational nursing staff planning involves a period of one day. This study will refer to operational nursing staff planning as the 'task allocation problem'. Strategic admission planning involves the determination of the types of patients to be admitted to each nursing unit. Tactical admission planning involves the determination of the day and time of admission per patient. This tactical admission planning is also referred to as 'inpatient admission scheduling' by Smith-Daniels *et al.* Operational admission planning concerns the assignment of each patient to a room and a bed. Strategic nurse scheduling concerns scheduling decisions involving a period of about a year, covering, for example, the planning of each nurse's vacations. Tactical nurse scheduling involves determining those days and shifts when each member of the nursing staff is to report for work in the predetermined scheduling horizon. In general, the length of this predetermined scheduling horizon varies from two to six weeks. This tactical nurse scheduling is mostly referred to as the 'nurse scheduling problem'. Operational nurse scheduling concerns rescheduling caused by illness, on a daily basis.

1.3 Definitions of nurse scheduling

The tactical nurse scheduling is simply referred to as nurse scheduling, but 'nurse shift scheduling' by Chen & Yeung, or 'nursing staff

scheduling' by Okada & Okada, 1988 are also used. Nurse scheduling is the procedure for providing nursing care by assigning shifts to nursing personnel. To be more specific, nurse scheduling is the process of determining when each nurse of a nursing unit will be on or off duty, which shift will be worked, by whom, and how weekends, the number of consecutive days worked, requests, and vacations will be accounted for Fluharty, 1988. Nurse scheduling involves three ranges .The first range concerns the nursing staff. Members of this nursing staff might differ concerning their professional category *e.g.* registered nurses, licensed practical nurses, nursing assistants, and student nurses or trainee nurses, or their labour contract *e.g.* full time or part time. The second range concerns the days of the schedule period. These days can be divided into two types: special working days *i.e.* public holidays or weekends, and regular working days *i.e.* all remaining days. The third range of nurse scheduling concerns the shifts to be assigned to a member of the nursing staff on a particular day of the schedule period. These shifts can be divided into two groups: 'productive' shifts *i.e.* day shifts, evening shifts, and night shifts and 'unproductive' shifts *e.g.* day off or special leave. In the case of the nurse scheduling problem, each productive shift's beginning and duration is fixed.

2. Nursing Schedule Quality

Nurse scheduling involves three parties with different interests. These parties are the nursing personnel working at the nursing unit, the patients admitted to this nursing unit, and the management of the nursing unit. These parties can strongly differ in their views on the intended quality of nursing schedules.

2.1 The nurses' view on nursing schedule quality

Nurses have a strong interest in nurse scheduling because their social and family life is highly restricted by the scheduled working hours. Also the health of nurses is strongly influenced by the irregularity in working hours by Van Emmerik, 1992. To reduce the health impairment for nurses, Dutch nurse schedulers are obliged to take into account a number of regulations by Grunveld, Van der Speld & Overbosch, 1993. Furthermore, nurses in most nursing units can specify general preferences and incidental requests. These preferences concern, for example, a fixed evening off *e.g.* sports evening, while special requests mostly concern a day off *e.g.* a wedding. By means of these preferences and requests, nurses can influence their own working schedules. The nurse scheduler decides which of these preferences and requests can be granted. The nurses' view on nursing schedule quality concerns the impairment of health and of social and family life. To stress this view, Bisseling introduced the concept of 'schedule contentment', which he defined not only as the employee's contentment concerning the scheduled shifts, but also as the contentment about several 'schedule risk criteria' , the (in)convenience of the working hours, the potential for recovery and the employee's opinion about her or his health.

2.2 The patients' view on nursing schedule quality

The high-quality nursing care is strongly influenced by the continuity in the daily scheduled

nurses by Marquis & Huston, 1994, a second party with an interest in nurse scheduling is the patients. Furthermore, the numbers of nurses and their levels of nursing expertise also influence the quality of nursing care. Patients will prefer health care organizations with nursing schedules that facilitate high quality nursing care. Patient-centred health care organizations will therefore try to provide patient care with high continuity. This means that a patient-centred management view includes this patients' view. Summarizing, the patients' view on nursing schedule quality concerns the continuity in the daily scheduled nurses, together with a sufficient amount of nursing expertise.

2.3 The management view on nursing schedule quality

A third party with an interest in nurse scheduling is the (financial) management of the nursing unit. This interest is based on the fact that the efficiency of a nursing unit determines the costs to a large extent. This not only involves the total of the monthly salaries, but also a number of problems related to nurse scheduling. High turnover, absenteeism and poor job performance are prevailing problems for nursing management in health care organizations. The stressful working environment, the uncompetitive salary, the lack of a positive career image and the irregular working schedules are factors which contribute to these problems .A management view on nursing schedule quality will therefore include these factors. Summarizing, the management view on nursing schedule quality concerns the effect of these working schedules on the efficiency of the nursing unit

2.4 The nurse scheduler's view on nursing schedule quality

When arranging nursing schedules, nurse schedulers, as administrators of the nursing unit, take into account all the consequences nursing schedules have for the performance of the nursing unit. These consequences are stressed by the interests of the nursing unit's nurses, patients or financial management. Mostly, these interests are conflicting, which makes it impossible to arrange a schedule which is best according to all views. Therefore, a nurse scheduler tries to arrange a nursing schedule which is as good as possible taking into account all the consequences of this schedule for the parties involved. However, the priorities given to each of these consequences might very well differ per health care organization, nursing unit or nurse scheduler.

3. Nurse Scheduling-Decision Support

The nursing schedule is an outcome of the process of nurse scheduling. An improvement of nursing schedule quality will therefore require an improvement in the process of nurse scheduling. The following subsection discusses four types of influence on nurse scheduling that could facilitate an improvement.

3.1 Nurse scheduling-Origin

The actual process of nurse scheduling is influenced by the scheduling skill of the nurse scheduler, the method of scheduling applied to arrange nursing schedules, all kinds of scheduling regulations and all kinds of scheduling support. Examples of increasing nursing schedule quality by means of improving the method of scheduling are given by Diekema, 1994 and De Vries-Griever

and colleagues 1994. Regulations by Dutch law designed to improve the quality of nursing schedules are described by Grunveld, Van der Speld and Overbosch 1993. The fourth influence on nurse scheduling concerns the support of this task by means of computer programs or other kind of tools. For more than two decades, researchers have been trying to develop computer programs in order to support the task of nurse scheduling by Warner & Prawda, 1972; Arthur & Ravindran, 1981; Ozkarahan & Bailey, 1988; Okada, 1992; Chen & Yeung, 1992; Mietus, 1994; Weil *et al.*, 1995. The present study also follows this management informatics approach. It focuses on the influence of the support of computer programs on the task performance of nurse scheduling. The next subsection describes this influence as a link in a quality chain.

3.2 Nurse scheduling – quality

During the last decades, many scientific studies have been conducted in order to support the task of nurse scheduling by means of a computer program by Warner & Prawda, 1972; Arthur & Ravindran, 1981; Ozkarahan & Bailey, 1988; Okada, 1992; Chen & Yeung, 1992; Weil *et al.*, 1995. The idea behind these studies is that the performance of the task of nurse scheduling can be improved by using a nurse scheduling support system (NSSS). Hofstede 1992, shows that this type of intended improvement is one link of a quality chain by also Simons & Verheijen, 1991. The quality chain is, Unit performance ← Nurse Schedule ← Nurse Schedulling ← NSSS ← NSSS development , this quality chain applied to nurse scheduling. The final link in this quality chain of nurse scheduling support systems concerns the consequences of nursing schedules for the performance of the nursing unit. Or to put it differently, the quality of nursing schedules affects the 'quality' of the nursing unit.

Furthermore, the nursing schedule quality is affected by the 'quality' of the nurse scheduling task performance. And as stated above, this quality of the nurse scheduling task performance is affected by the 'quality' of the nurse scheduling support system. Finally, the quality chain of nurse scheduling support systems starts with the link between the 'quality' of the development of the nurse scheduling support system and the resulting nurse scheduling support system. The objective of this study is to increase the quality of nursing schedules by Operationalizing the quality concept in such a way that it positively influences all three performance characteristics of a nursing unit discussed in the first section (*i.e.* the effectiveness in providing nursing care, the efficiency of a nursing unit and the job satisfaction of the nursing staff).

The operational quality can be used in the development of the nurse scheduling support system, the use of this system and the task performance of nurse scheduling, and will therefore possibly result in nursing schedules that positively influence the performance of a nursing unit. Research that operationalizes the quality concept of nursing schedules in such a way has not yet been conducted, mainly because most research on nurse scheduling focuses too much on solving the nurse scheduling problem according to one or two views on nurse scheduling quality

discussed in the previous section. This limited focus is probably a result of the difficulty in solving the nurse scheduling problem. The following subsection describes why it is difficult to develop this type of nurse scheduling support system.

3.3 The nurse scheduling problem-Difficulty

A nurse scheduling support system is a specific type of decision support system. An important part of a decision support system is its model base (Bonczek, Holsapple & Whinston, 1981). In general, a decision support system's model base is developed in four phases. Nurse scheduling presents a difficult problem to model and solve (Okada & Okada, 1988). This problem is hard to solve for three main reasons, which are the complex data structure, the large number of possible solutions and the large number of constraints. The first reason disturbs the translation of the problem as perceived in reality into a model of this problem, while the last two reasons disturb a computation of a solution of the modelled problem. Below, these three reasons are discussed in more detail. The nurse scheduling problem is hard to solve because of its complex data structure containing all kinds of employee information and schedule data (Courbon & Esaki, 1992). Several skill categories (*e.g.* registered nurses, licensed practical nurses and nursing assistants) are utilized to provide the blend of talents necessary for patient care. The blend of talents required can vary on a unit from shift to shift, depending upon the medical treatments typically provided (Smith & Wiggins, 1977).

The difficulty in solving the nurse scheduling problem is the very large number of possible nursing schedules combined with the lack of an efficient search algorithm. This can be illustrated by calculating the number of possible nursing schedules for a fictitious nursing unit. At the nursing unit, a nursing schedule is arranged every four weeks. Each twenty-four hours, needs two nurses on the night shift, three nurses on the evening shift, and five nurses on the day shift.. The nursing schedule for the unit contains four weeks of seven days, which makes twenty-eight days. A third reason for the difficulty in solving the nurse scheduling problem concerns the large number of complicated constraints.

Example, the labour contract between the hospital and the nurse can place a variety of restrictions on the types of schedules the nurse can perform (Rosenbloom & Goertzen, 1987). The large number of complicated constraints cannot easily be applied to limit the space of acceptable solutions (Smith & Wiggins, 1977; Weil *et al*., 1995). These constraints concern, for example, continuity in service, personnel policies, staff preferences, operating budgets and labor constraints (Rosenbloom & Goertzen, 1987). Additionally, some of these considerations may be in conflict with others, such as employment requests and the need to balance the workload (Randhawa & Sitompul, 1993). Also Ozkarahan and Bailey (1988, p. 306) stress the conflicting objectives and constraints of the nurse scheduling problem. As described above, much research has been conducted to support the performance of the nurse scheduling task by means of a nurse scheduling support system.

4. Conclusion

This paper showed how to analyze, operationalize and apply of the concept of nursing schedule quality. The analysis was based on the search for independent factors. The operationalization used the communality among nurse schedulers about the interpretation of these factors. And finally, the application showed the effectiveness of informing nurse schedulers about the values of these factors. Therefore, this paper showed that task of nurse scheduling can be effectively supported by means of quality indication scheduling. This approach supports the nurse scheduler by providing quality indicators that measure the schedule's value for each quality factors.

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