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# Computerized measuring of nursing professionals: technological innovation\*

DIMENSIONAMENTO INFORMATIZADO DE PROFISSIONAIS DE ENFERMAGEM:  
INOVAÇÃO TECNOLÓGICA

DIMENSIONAMENTO INFORMATIZADO DE PROFESIONALES DE ENFERMERÍA:  
INNOVATION TECNOLÓGICA

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## ABSTRACT

The aim of this technological production study was to develop a program to measure nursing professional chart in units of hospitalization. The method followed the phases of conception, description, construction and prototyping of the system interactively and a cyclically. The computerized program, denominated Measuring Nursing Professionals (DIPE) is a tool that operationalizes measurement based on the workload of the unit for the adequate professional/patient relationship according to types of care, according to the Index of Technical Security to cover expected absences (day-off and vacation) and those non expected (leave and licenses) and also time spent during work for pauses of professionals. The system is available in the site of the Nursing School of USP: <http://www.ee.usp.br/dipe>. The incorporation of this technological development became important managerial instrument to improve quality in health attention.

## KEY WORDS

Personnel management.  
Nursing staff hospital.  
Nursing informatics.  
Workload.

## RESUMO

Esse estudo, de produção tecnológica, teve como objetivo desenvolver um programa aplicativo para dimensionar o quadro de profissionais de enfermagem em unidades de internação hospitalar. O método seguiu as fases de concepção, detalhamento e construção e prototipagem do sistema de forma iterativa e cíclica. O programa computacional, denominado de Dimensionamento de Profissionais de Enfermagem - DIPE, é uma ferramenta que operacionaliza o dimensionamento, fundamentado na carga de trabalho da unidade, para a adequada relação profissionais/pacientes, segundo os tipos de cuidado; no Índice de Segurança Técnica (IST) para cobertura das ausências previstas (folgas e férias) e não previstas (faltas e licenças) e no tempo despendido na jornada de trabalho para as pausas dos profissionais. O sistema está disponível no site da Escola de Enfermagem da USP: <http://www.ee.usp.br/dipe>. A incorporação desse avanço tecnológico constitui importante estratégia gerencial para a melhoria da qualidade da atenção à saúde.

## DESCRIPTORES

Administração de recursos humanos.  
Recursos humanos de enfermagem no hospital.  
Informática em enfermagem.  
Carga de trabalho.

## RESUMEN

Ese estudio de producción tecnológica tuvo como objetivo el desarrollo de un programa aplicativo para el dimensionamiento del cuadro de profesionales de enfermería en unidades de internación hospitalario. La metodología siguió las fases de concepción, detalle, construcción y prototipaje del sistema de forma interactiva y cíclica. El programa computacional, nombrado como Dimensionamiento de Profesionales de Enfermería - DIPE, es una herramienta para la realización del cálculo de personal basado en la carga de trabajo de la unidad y la adecuada relación profesional/paciente, según los tipos de cuidado, en el Índice de Seguridad Técnica (IST) para cobertura de las ausencias previstas (descanso y vacaciones) y las no previstas (ausencias y licencias) y en el tiempo utilizado por los profesionales en sus pausas. El sistema esta disponible en el sitio de la Escuela de Enfermería de la Universidad de São Paulo: <http://www.ee.usp.br/dipe>. La incorporación de esa tecnología constituye una importante estrategia gerencial para la mejoría de la cualidad de la atención de salud.

## DESCRIPTORES

Administración de personal.  
Personal de enfermería en hospital.  
Informática aplicada a la enfermería.  
Carga de trabajo.

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## INTRODUCTION

Threats to health result in a demand profile of the population marked by diseases. A lack of ability to provide efficient and effective care, allied to the aging of the population, make clients every day more dependent on sophisticated and expensive technological resources.

This complex scenario challenges the Brazilian health care system to deliver care according to quality services demands, providing care with efficiency and effectiveness. For this reason, finding new ways to manage the available resources for its survival is necessary.

In light of this context, instruments that enable better management of nursing professionals have been sought after. Knowledge has been produced and abilities and competencies have been developed that allow for planning, allocating, distributing and controlling health services nursing staff.

In this manner, the measuring method for nursing professionals proposed by Gaidzinski<sup>(2)</sup> enables the identification and analysis of the intervening variables in this process. The method is an auxiliary instrument for planning and evaluating nursing services, since it allows for the building of a nursing staff projection chart for health services yet to be installed, in addition to evaluating nursing professionals' qualitative and quantitative features in functioning units.

This method also provides information on which to base care programs economic feasibility analysis and the decision processes regarding resources allocation and costs reduction, without damaging the quality of care<sup>(3)</sup>.

As the proposed method was refined and consolidated, adding analysis and countless variables calculations, it allowed for better visibility of the reality of these services. On the other hand, it generated more difficulty in putting it into practice in human resources management daily tasks.

Hence, turning to computerized resources by developing a software program that will allow managers to access and use effective quantitative and qualitative information to appropriately plan nursing staff and streamline the decision-making process saves costs, time and energy, and is absolutely necessary at a time when health care costs are soaring.

## OBJECTIVE

Develop a computer software program that will integrate the professional nursing staff measuring method into hospital units.

## METHOD

This is a methodological applied study of technological production, aimed at integrating the operating measuring method model for nursing professionals into hospital units.

The development methodology of the computerized process followed the phases of concept, detailing, construction and prototyping of the system in a cyclical and interactive way<sup>(4)</sup>.

Project management was based on concepts outlined by the Project Management Institute-PMI. This institute represents a compound of best practices principles, characterized by continuous communication of everyone involved, aligned to activities, functions and procedures to follow up the development of the system<sup>(4)</sup>.

In the concept phase, the project draft was defined along with the necessary resources for its execution. Data were mapped, organized and interpreted based on the Gaidzinski<sup>(2,5)</sup> method which considers the following variables: workload, Technical Safety Index (TSI) and the staff's effective working time. The model variables were organized and conceptualized based on the construction of an essential data compound related to nursing professional staff measuring in hospital units: *Nursing Management Minimum Data Set – NMMDS*<sup>(6)</sup>.

The detailing phase was featured by the browsing map and the translation of the Nursing Management Minimum Data by using technological resources, where the executing processes to develop the system were described. These resources allowed for the development of use cases whose purpose was to examine the method's stages regarding nursing professional staff measuring according to different types of hospital units: events flow (basic and alternative) and browsing flow. The proposal was specified according to the Unified Modeling Language Model (UML)<sup>(7)</sup> which allows for modeling a system guided to objects, facilitating software maintenance.

The construction and prototyping phase was composed of the application development by refining system requirements and testing its components.

The project was approved by the Research Chamber and by the Research Ethics Committee of the HU-USP (REC registration – HU/USP: 719/06).

## APPLICATION AND ITS WEB SUPPORT DEVELOPMENT

The construction of the software was carried out in the following stages:

Is necessary developing a software program that will allow managers to access and use effective quantitative and qualitative information to appropriately plan nursing staff.

### Conceptualizing phase

This was the most relevant and difficult phase, since it dealt with elements that supported the computer system structure. Hence, a group of nurses and researchers, graduate and post-graduate teachers and students, in addition to the professionals from the company hired to perform data modeling and the construction of the system, was put together.

Once this was completed, data regarding the following categories<sup>(6)</sup> were identified, conceptualized and detailed: environment and human resources.

The environment category, which determines the workload of the unit, refers to the data that includes the care environment context: type of unit and number of beds according to the types of care and interventions (nursing interventions types and patient classification instrument that correlates care delivery average time).

### Types of units

The following types of hospital admittance units were considered: Adult Internal Medicine, Adult Surgery Clinic, Adult Surgery-Internal Medicine, Pediatrics, Maternity (with or without Rooming-in Care System), Nursery, Adult General Intensive Care Unit, Cardiology Intensive Care Unit, Pediatrics Intensive Care Unit, Neonatal Intensive Care Unit, and Semi-Intensive Unit.

### Number of beds

The capacity of bed units for hospital stay depends on the availability of beds to accommodate patients. The number of beds depends on the patients demand forecast for the area covered by the planned unit.

The amount of patients staying in hospital is a random variable, where the value changes daily due to patient discharges and admittances during the day. Discharges and admittances depend on the maximum number of beds available in the unit.

Taking into account that in order to measure staff, this variable's values are average daily values and the admitted patients sample can be treated under normal distribution. Fifty percent of the working time in the unit the workload will fall below the average level, and the other fifty percent of the time the workload will be above the average value, resulting in service overload of the nursing team.

In order to minimize the nursing team's service overload, a standard deviation of the average amount of patients in the unit was added so that the nursing team can work with 84.13% (50% + 34.13%) of time, with no resulting overload.

Nursing services quality delivered to patients admitted to the hospital will depend on the objective targeted by the hospital stay unit where the nursing team intends to measure itself. Therefore, system users may choose one of the levels that will influence service quality according to

the hours spent in patient care and in attributions of the hours by nursing professionals' category, according to Fugulin et al.'s<sup>(8)</sup> Patients Classification System, and to the following options:

**Level I** – Follows formal, technical and structural requirements for the activity. Nursing professional staff is calculated based on minimum care hour values per patient and on the nursing team composition in order to meet basic requirements to deliver care to users. Specialized technical professionals perform nursing services. Specific risks identification and safety-focused management.

**Level II** – Hospital stay units calculated with average care hours per patient and the recommended nursing team composition based on research performed in hospitals that, besides the requirements in Level I, present the following: definition, standardization and work process documents, indicators, measuring methods and results evaluation definition, education and continued training programs.

**Level III** – Hospital stay units calculated with average care hours per patients and the recommended nursing team composition based on research performed in hospitals that, besides the requirements in Level II, present planning systems and continuous improvement regarding structure, new technologies and professional technique updates. It includes performance index systems that allow for comparison with pertinent external references.

Care average times were based on COFEN Resolution No. 293/04<sup>(9)</sup>, considered as appropriate in research studies performed in hospital stay units in various public and private health institutions, located in the city of São Paulo<sup>(10)</sup>.

The percentage of care time distributed among nurses that compose the nursing team was established based on studies available in literature<sup>(10)</sup> and by observing workload prevalence according to COFEN recommendations in Resolution No 293/04<sup>(9)</sup>, since the recommended proportions are still elevated for Brazilian hospital service reality.

The human resources category describes the following professional aspect: Productivity: Technical Safety Index (TSI), or the additional amount of professionals required to cover the expected (vacation and days off) and the non-expected (absences and leaves) absences and professional work period in qualitative and quantitative terms.

The nursing staff work day option separates the daily service period division of the unit into three shifts (Morning, Afternoon and Night for 8-hour work days) and into 4 shifts (Morning, Afternoon, Night 1 and Night 2 for 6-hour work days) or 12-hour shifts.

Nursing professionals' productive time refers to the hours used for care delivery. The time considered as non-productive is the time used for breaks during the work day for personal needs (meals, water drinking, rest, physiologic needs, co-fraternizations, socializing with work colleagues, personal phone calls).

According to the literature, productivity levels lower than 80% indicate that nurses have a higher probability of being satisfied with their work resulting in reduced absences<sup>(11)</sup>, while levels higher than 80% lead to cost increases and care quality reduction<sup>(12)</sup>.

In order to maintain daily care as uniformly as possible, avoiding work overload, nursing management should have a higher number of professionals than necessary for each single day of care delivery. Therefore, the unit must have an extra number of professionals for all categories, specifically to cover nurses' expected absences (days off and vacations) and non-expected absences (absence and leaves). This increase in staff is needed to maintain the Technical Safety Index (TSI) and is calculated according to the information provided by users (weekly days off, average number of vacation days, absences and licenses).

### Detailing phase of the System

The system prototype was built utilizing interfaces and functionalities based on the information surveyed in the previous phases, including use and quality paradigms in the user/system relationship through the use cases diagram.

In this phase, data modeling was done aiming at uniquely, non-redundantly and in a continuous way, transmitting and representing data for system construction.

Data storage model was a relationship design, structured into tables that enable data relationship by class diagrams.

System web interface was established by using Microsoft® NET platform.

System functionality, regarding its access, encompasses safety rules through functional and administrative profiles. Therefore, the administrative profile of the system regards system basic table maintenance. The functional profile demonstrates how the system responds to users' requirements. Users' access to the system is allowed by using a login and password, ensuring safety, confidentiality, integrity and information availability standards.

### System construction and prototyping phase

A system functional prototype was developed. It comprised a preliminary version of the application. In this phase, meetings to validate functions and approve system construction were held between the groups of researchers and the company.

The system developed was named *Nursing Professional Measuring method – NPM (DIPE in Brazilian acronyms)*, a computer software program that aims at planning and evaluating the quantitative and qualitative measuring of nursing professionals for a hospital unit.

The DIPE system was installed in the USP Nursing School website: <http://www.ee.usp.br/dipe>

To access the system, users must register and receive confirmation of registration by e-mail. (Figure 1).



Figure 1 - Initial register page



The administrator profile page has a register menu that has the general tables' insertion processes, approval and maintenance (Figure 2). General tables enable altering and adding unit types, care time and levels, functioning type of the unit, shifts, professional category, and

team's productivity levels. Upon approval of the administrator, users may post articles, theses and other types of scientific productions. Maintenance enables the administrator to access all research and data produced by users.



Figure 2 - Administrator's page

## FINAL CONSIDERATIONS

The technological product developed enables users to put intervenient variables into practice in a measuring method, providing for a higher safety perspective for patient care and professionals' occupational health. DIPE makes nursing professional staff projection available for hospital units and stay units by calculating qualitative and quantitative nursing work load distribution to appropriately relate professionals/patients. It also allows the inclusion of the Technical Safety Index (TSI) for covering the expected (day off and vacations) and non-expected

(absence and licenses) absences and the time spent in the work day for workers' breaks. The software represents progress in teaching and resources management. In addition, it can be adjusted to measure other health professionals. Making the system available through a free Web platform to all interested parties will open new possibilities for spreading this knowledge in resource management. Incorporating this technological progress constituted an important management strategy to improve health care quality for the Brazilian population. Finally, it enables the development of human resources providing scenario comparison methods to support indicator proposals of nursing professional management.

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