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Conceptualization of an Electronic System for Documentation of Nursing Diagnosis, Outcomes, and Intervention

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Abstract

Electronic nursing documentation constitutes technical, scientific, legal, and ethical documents. The objective of this study was to develop an electronic nursing documentation system. The system was developed in four phases (conceptualization, detailing, prototype building, implementation), and the knowledge base was based on domains and classes according to the NANDA-I, NIC, and NOC unified framework. The result is an electronic system (PROCEnf - USP - Nursing Process Electronic Documentation System of the University of São Paulo) which allows documenting nursing process generating reports of nursing process, besides supporting decisions on nursing diagnosis, expected outcomes, and interventions. Integration of different fields of knowledge, as well as the institutional feature of valuing continuous theoretical and practical improvement of nursing process were factors of success of this technological project.

Keywords:

Nursing informatics, Computerized medical records systems, Nursing diagnosis.

Introduction

The clinical nursing documentation has been oriented by the Nursing Process (NP). In Brazil, the NP was introduced in the 1970's by Wanda de Aguiar Horta to make nursing (which was conceived as the science that deals with human care treating the basic needs of the human being [1]) operational.

After using the NP in teaching and health services, it became known and recognized by the title of *Systematization of Nursing Assistance* (SAE). In this text, the expressions 'NP' and 'SNA' will be used with the same meaning, and describe a tool that provides a systematic guide to assist nurses develop a "a style of thinking that leads to appropriate clinical judgments" [2].

The NP orients a style of thinking in a continuum of questioning-answering-questioning in dynamic contexts for making appropriate decisions about what the patients' care needs are (diagnoses), what the expected outcomes are(outcomes), and what are the best nursing actions to meet the expected outcomes (interventions) [3].

Nursing documentation, in addition to providing technical, scientific, legal and ethical documents, and providing health institutions with important records for billing purposes, subsidizes the audit of nursing actions, and above all, allows estimating quality of care provided to the client [4].

However, one can observe that current nursing documentation often presents problems in terms of accuracy and relevance, and is rarely used to evaluate the care given.

The combination of three elements has been the focus to improve nursing documentation: definition of core data which should be included in each care meeting [5-6], internationally acknowledged as *Nursing Minimum Data Set* (NMDS), use of standardized language systems (or classification systems) [7-8], and networking [9].

Classification systems like *NANDA-International (NANDA- I* [10]*)*, *Nursing Interventions Classification (NIC)* [11] and *Nursing Outcomes Classification(NOC)* [12] are tools to improve reliability, validity and usability of nursing documentation.

In an attempt to integrate the classifications, NANDA-I, NIC, and NOC Alliance proposed a framework called NNN (NANDA, NIC NOC), which establishes a set of four domains and twenty eight classes to organize in a single framework the contents of NANDA-I [10], NIC [11], and NOC [12].

Using NNN framework in an electronic nursing system improves documentation, encourages nurses to adopt the NP, and improves diagnostic accuracy and patients' outcomes [13-14].

Computerized systems must overcome the mere transfer of documentation from paper to computer, and the "*check lists"* of diagnoses and nurses' orders emphasizing decision making

and nursing clinical judgment in patient care, expanding and supporting nurses' clinical decision

Decision Support Systems (DSS), which use databases (facts and/or rules), designed to assist a health professional in the process of clinical decision making have a great potential to help nurses cope with the required amount of data and information [15].

The Nursing Department (ND) of the University Hospital of the University of São Paulo (HU-USP), since its establishment, has implemented the NP in clinical practice. Aware of the advances in information technologies for health systems and the importance of ensuring that nursing was prepared for it, the ND included the computerization of clinical nursing documentation in its goals. Thus, since 2000 computerization of clinical nursing documentation was the main concern leading to the implementation of nursing classifications [16]. In 2003, by gathering researchers from the School of Nursing of the University of Sao Paulo, and nurses from the HU-USP, the project received a grant from the National Council for Scientific and Technological Development (CNPq), which enabled the leverage of the project to build a DSS for the nursing process and its documentation.

This paper reports the development of the system and its features.

Objective

To develop an electronic system for nursing documentation supporting adult clinical and medical patients' assessment documentation, and decision on nursing diagnoses, expected outcomes and interventions.

Method

This was a methodological research on technology production in the modality of case study. The system development method used 4 cyclical phases of technological product development: Conceptualization, Detailing, Prototyping and System implementation, adopting a project management model based on the *Project Management Institute* (PMI) [17].

The project presents a data model that enables electronic documentation of NP data of medical and surgical adult patients admitted in the HU-USP.

To develop the project, a multidisciplinary work group was established. The scope of the project was limited to NP documentation, in a way that it could be integrated into the hospital system of clinical documentation, .

The Steering Group of the system development was constituted by the Director of the ND, the Director of the Clinical Nursing Division of the HU; a nurse from the Nursing Continuing Education Service of the HU; two faculties of the School of Nursing of USP, and two staff nurses from Clinical and Surgical wards of HU-USP. In detailing phase for modeling data and system development, HU-USP contracted a company that had previously developed other systems for the Institution. Validation of use cases and system approval was done by Steering Group meetings with the technicians of the contractor company and a representative of the IT Department of the HU-USP.

Considering other areas within the ND will eventually incorporate the system, Directors and representatives of the Maternal-Child Nursing and External Patients Nursing Divisions were contacted, aiming at helping to organize materials the for databases.

It is noteworthy that nursing diagnosis classification was effectively in use in all the HU-USP wards since 2005 and that nurses developed tools to manually document nursing diagnoses, nurses orders and progress notes [18], which guided the construction of the electronic system.

The research project was approved by the Ethics and Research Committee of the Institution.

Results

PROCEnf-USP (Nursing Process Electronic Documentation System of the University of São Paulo) was developed in four planned phases.

The conceptualization phase emphasized the scope of the system, and established basic requirements. To do so, clinical and managerial Minimum Nursing Data was identified, and questionnaires were prepared to guide assessment data documentation needed for nursing diagnoses for clinical and surgical patients [17].

The framework for clinical assessment documentation was organized according to a database based on nursing diagnosis definitions and their components, following the hierarchy of domains, and classes proposed by the unified framework of NANDA-I, NIC and NOC [19], which could be a documentation guide able to generate a list of nursing diagnosis hypotheses in accordance with assessment data documented in the system.

Then, the automatic method used in the patient's nursing assessment record was to develop a "branched questionnaire" in which the nurse would go through several questions which could be customized for each patient [15].

The *PROCEnf-USP* guides the nurse to respond to a set of questionnaires with tabulated responses that lead to a set of likely diagnoses supporting the generation of diagnostic hypotheses. The evaluation, analysis, and choice of the defining characteristics, related factors and risk factors applicable in the structured database of likely diagnoses, allow the nurse to decide the set of diagnosis that best fits the patient's responses at admission, according to the nurse clinical reasoning, which corresponds to the phase of hypotheses testing, and final decision in the diagnostic process.

The branched questionnaire was developed by the Steering Group with questions based in the definitions, defining characteristics and related factors/risks of each diagnosis. For each class of unified framework of NANDA-I, NIC and NOC[19], questions were created on related subjects, whose answers include at least one cue for every diagnosis in the same class. In addition to the questionnaires for the 28 classes of the NNN structure, 4 other questionnaires which are required to admit any patient (social and demographic data, events which led to service, vital signs and conditions when arriving to be serviced) were created. The NMDS and the previously established institutional protocols guided the

definition of the additional content to the NNN structure. Once documented, the data of these 4 additional questionnaires which are relevant to any NNN class, are automatically copied to the class(es) in which they belong.

The linkages between answers and diagnoses were defined by consensus in the Nursing Group, based on the NANDA-I classification [10], the theoretical framework of reference areas, as well as on the clinical experience of nurses. In order to guarantee the linkages between answers and diagnoses in the logical system, every diagnosis had to have at least one answer they could be linked to. A rule was adopted that it was necessary that all diagnoses could be hypothesized at least once through the answers to questions included. Thus, after the nurse documents data collected (in total or in part), the system itself presents automatically the diagnostic hypotheses (calculated diagnoses). Then, the calculated diagnoses (hypotheses generated by the system) are confirmed or refused by the nurse, ensuring that final decision on the determination of the diagnosis is made by the user.

When relevant, questions with the same statement and same possible answers were repeated in more than one questionnaire (class), as recursive questions. These recursive questions, once documented in a class, are automatically documented in the other class(es) in which they are present. This avoids the duplication of work without violating the structure defined for the organization of questionnaires.

In order to support the choice of nursing outcomes and interventions, possible linkages between diagnoses and expected outcomes and between outcomes and interventions pertinent to the context of HU-USP were introduced in the system. Therefore, the components of the Nursing Classifications Advanced Node (NACEnf)[1] of the ND mapped 66 nursing diagnoses which are the most frequent in the Institution; for each one of these diagnoses, expected outcomes in the scope of HU-USP were chosen; for each outcome, interventions and activities pertinent to practices of the HU-USP were also chosen. Nursing diagnoses, outcomes and interventions were linked, therefore integrating NANDA-I [10], NOC [11] and NIC [12] classifications. Nursing diagnoses and expected outcomes were included in linkages according to their titles, and interventions were linked according to the activities recommended by the NIC. Linkages were based on available literature and reflections on clinical nursing practice in the Institution.

In the Detailing phase, software that would be used to develop the system was selected, as well as Use Cases, system interfaces and conceptual, logical and physical data modeling were described, adopting paradigms of ease of use and good quality user interface system. System specification documents followed current HU-USP standards, which use a sub-set of *Unified Modeling Language* - UML.

Information system project requires the use of databases characterized as structures of data storage and organization, arranged in a predetermined order according to system design, aiming at reorganizing data and producing certain information [20]. A database is usually maintained and accessed through software known as Database Management System (DBMS), which provides an interface (characterized as managing module) so clients can add, change or retrieve data.

In this project, the chosen database was Oracle®, because it is the tool used by HU-USP. This database provides an interface for customers to add, change, or retrieve data using a specific programming language: PL/SQL (*Procedural Language/ Structured Query Language*).

The data storage model used was relational, structured in the tables that allow for data relationship.

Platform.NET, a Microsoft® *framework* developed for internet, was used to establish the system web interface. F*ramework* is understood as a group of methods, standards and classes which define and offer resources for the development of systems.

The system has two environments: professional and academic. The professional environment will be used for documenting data of actual patients. The academic environment will enable the simulation of situations for teaching purposes with the same characteristics of actual clinical documentation, in which nurses, students and teachers register fictitious patients and simulate making diagnoses, selecting outcomes and interventions. The creation of fictitious patients prevents real patients from being included for education outside the field. This procedure is necessary to educate students and nurses and to keep the non-violation of ethical elements recommended.

When preparing the prototype, a preliminary version of the system was developed (functional prototype) aiming to verifying functions and business rules, and to observe system operation, facilitating the visualization of system constraints and system validation. During this phase, meetings were held to validate functions and business rules in the system.

During implementation phase, the system entered into a testing environment. Several versions were tested, and the system was finally approved by the Steering Group to enter into the production environment. In this phase, the system was installed on the HU-USP server, and *login* and access passwords were distributed to users.

PROCEnf – USP

The system allows the user, whether a nurse or a student, to make clinical decisions, supporting judgments to establish nursing diagnosis, expected outcomes and nursing interventions.

The user can choose between two paths, depending on their needs, being allowed to enter assessment data and view nursing diagnosis hypotheses generated by the system or to directly choose nursing diagnoses. Stages to be covered by the user follow clinical reasoning from documenting interview and physical examination data to documenting nurse orders.

To document data and care planning, the user shall follow *PROCEnf - USP* steps, detailed below:

1. Assessment**:** to begin documenting the assessment, it is necessary to choose an actual patient (in the professional environment) or a fictitious patient (in the academic environment).

[1]Nursing Classifications Advanced Node (NACEnf): Research support group created by the Nursing Department of the HU-USP aiming at deepening the application of standardized nursing language systems in the clinical practice of nurses.

2. Answer Questionnaire: the user shall answer the required Questionnaires and have the option of responding to the remaining Questionnaires (which are structured according to NNN classes) which it deems appropriate. Answers to Questionnaires generate Nursing Diagnoses hypotheses.
3. Calculate diagnosis: the system will show all diagnostic hypotheses on the screen, so the user can view Defining Characteristics, Related Factors, or Risk Factors that were identified through the answers documented in questionnaires.
4. Indicate diagnosis: the user can include Nursing Diagnoses in addition to the system hypotheses. On this screen, one has the option to look up Nursing Diagnoses definitions and add Defining Characteristics, Related Factors, or Risk Factors.
5. Select diagnosis: the user is responsible for choosing the most accurate diagnosis for the care of the patient.
6. Outcomes: after the decision on nursing diagnosis(es), the system will indicate the possible outcomes for each diagnosis, and the user will select one(s) that best represents the goals to for patient's care plan. The system allows adding other outcomes besides those automatically suggested.
7. Interventions: after the choice of Nursing Outcomes, the system will indicate the possible Interventions related to the Outcomes selected. The system allows the inclusion of other Interventions.
8. Activities**:** the system presents a set of nursing activities for each Intervention decided by the user. It allows the user to include other Activities that are linked or not to the Intervention selected. It is possible to add complementary information to an activity, such as "frequency" and "local application". The location of the patient's body related to the activity can be pointed out by the user by means of an iconographic system corresponding to the regions of the body.
9. Summary: the system displays a summary of the "Assessment" made by the user with the following data: evaluator's name, approver's name (certified nurses), questionnaires, diagnoses linked to their outcomes, interventions, and activities.
10. Reports: the user can request the following reports: "Assessment" (Nursing Diagnoses, Outcomes, and Interventions) "Daily Activities" (Nursing Diagnoses and Nurse Orders) and "Questionnaires".

Conclusion

The *PROCEnf-USP* will be registered as software by the USP Innovation Agency, and is ready to be implemented, evaluated, refined, and expanded.

Reasons because this technological production project was successful include institutional features (academic hospital, pro-active management of the ND; tradition in using nursing process; ND position in the organizational structure, for example), financial support, and positive attitudes toward collaborative work between clinical and research personnel from varied disciplines.

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