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Using ICNP for Nurse Electronic Charts and Protocols in Rehabilitation Divisions

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Abstract. The aim of this work is to promote the use of standard terminology for nursing documentation and for nurse protocols' description. We implemented an ICNP browser and we integrated it into two different systems: the nursing electronic patient record and the nursing protocols editor. The former allows nurses to choose ICNP terms for filling the clinical chart, while the latter allows computerising protocols using ICNP terms for the actions specification. Since, in a nursing information system, it should be worth to integrate protocols with the electronic patient record, sharing the same terminology is a crucial issue. We also show how we tailored the information system to the different wards. For each ward, we devised the most frequent patient needs and nursing actions. These lists are used to customise the different interfaces. Finally, by testing the prototype using real-world documents (clinical charts and protocols), we carried out an evaluation of the terminology itself, about its completeness and usability.

1. Introduction

ICNP® (International Classification for Nursing Practice) is a long-term project providing a structured terminology and a classification that can be used to describe and organise nursing data which can in turn be integrated into multidisciplinary health information systems [1, 2]. Objectives of the project are related to communication improvement among nurses, and between nurses and others. Availability of a common language is necessary condition in order to represent concepts used in local practice, describe the nursing care of people world-wide, enable comparison of nursing data, stimulate nursing research, provide data about nursing practice in order to influence not only the local organization of the work, but also nursing education and health policy making. ICNP is a classification of three components:

- *Nursing Phenomena* (NP) defined as "aspects of health of relevance to nurses practice", and described through the first axes set listed in Table 1. Focus and Judgement or Likelihood terms give rise to a nursing diagnosis.
- *Nursing Actions* (NA) defined as "behaviour of nurses in practice", and described through the second axes set listed in Table 1. A nursing intervention is an action taken in response to a nursing diagnosis and it is identified by the presence of a term in action type axis.

- *Nursing Outcome* (NO) defined as the measure or status of a nursing diagnosis at points of time after a nursing intervention. Outcomes are described as changes in nursing diagnosis.

Each term belonging to an axis is also completely defined by a sentence in order to avoid misunderstandings and the attribution of different meanings. Composing the coded terms for the axes it is hence possible to define many phenomena and actions in a unique way and with different degrees of detail. Coding schema follows a hierarchical model; as an example considering the "frequency" axis of NA, the coded terms are the following:

1C.1 Continuous
1C.2 Intermittent
1C.2.1 Very often
1C.2.2 Often ... etc.

Table 1: Axes of phenomena and actions

Compo-nent	Axis	Prefix	Definition
P H E N O M.	Focus	1A	The area of attention (pain, violence, etc.)
	Judgement	1B	Opinion, estimate or determ. of a NP state (inadequate, improved, etc.)
	Frequency	1C	N.of occurrences of a NP (intermittent, often, etc.)
	Duration	1D	Time interval in which a NP occurs (acute, chronic, etc.)
	Body site	1E	Anatomical position or location of a NP (eye, finger, etc.)
	Topology	1F	Anatom. region/extent of an anatom. area (right, total, partial, etc.)
	Likelihood	1G	Probability of occurrence of a NP (risk, chance, etc.)
	Distribution	1H	Diffusion of a NP among persons (individual, family, etc.)
A C T I O N S	Action type	2A	Deed performed by a NA (teaching, inserting, monitoring, etc.)
	Target	2B	Entity affected by a NA or provide NA content (pain, infant, etc.)
	Means	2C	Instrument/specific work or plan for a NA (bandage, discharge, etc.)
	Time	2D	Temporal orientation of a NA (at discharge, prenatal, etc.)
	Location	2E	Anatomical and spatial orientation of a NA (head, home, etc.)
	Topology	2F	Anatomical region/extent of an anatom. area (right, total, partial, etc.)
	Route	2G	Pathway through which a NA is done(oral, subcutaneous, etc.)
	Beneficiary	2H	Entity to whose advantage a NA is performed (individual, family, etc.)

In this work we exploited ICNP to standardise, as much as possible, the terminology currently used in both the nurse clinical charts and nursing protocols. In the same time, since the terms adopted in a terminology server often differ (in the form) from terms routinely used in clinical practice, particular attention has been devoted for avoiding boring changes for nurses. In the authors' knowledge, despite a variety of projects, there are few applications of this type [3]. We followed these steps: 1- choosing two pilot wards in our hospital and analysing a sufficient number of nurse documentation charts; nurses were not using an electronic patient record (EPR) yet, so they checked multiple choice lists or wrote free text on paper sheets; 2- developing a nurse information system, using a relational database and a web-based interface; 3- developing an ICNP browser; 4- integrating ICNP within both the developed information system and a pre-existing electronic protocol editor [4]; 5- tailoring the interface to the specific ward.

2. The User Needs Analysis

Pneumology and cardiology divisions were the two pilot wards. Twelve and eighteen complete clinical charts were collected from the two wards, respectively. The mean duration of hospitalisation was 19 days in the former and 7 days in the latter, for a total of

354 days analysed. We considered this was sufficient to collect almost all the different activities that nurses perform routinely.

The goal of the analysis was twofold: first to create a common relational database schema for the implementation of the EPR, having in mind the necessary customisations for the different needs of the two wards, and second to find a way of transforming free text sentences into codes. In fact, the initial evaluation of the patient is recorded using the NANDA [5] schema; while the daily log of nursing activities is written in free text format and these texts were subjected to the analysis.

The first issue was solved by creating, on the same database, different views, that are loaded at the login time, according to the user type (namely "pneumo-nurse" or "cardio-nurse"). The second issue, of most interest in this work, required first of all typing into a file the free text found in clinical charts. Then we used a software tool [6] able to isolate the sentence repetitions in a text, in such a way to order sentences according to their frequency. In this way, the "most used" sentences that nurses write to document their activity have been highlighted and used to compose a checklist for the EPR interface. When possible, an ICNP code was associated to a sentence, while when no ICNP code was found, we assigned our own code (to be converted as soon as future ICNP versions will embed that concept). The final result is that nurses continue to fill the records by choosing among a list of sentences they are familiar with, but the EPR stores only codified information.

2.1. *The Text Analysis Tool*

Given a text, the first task of a lexical analysis is to "normalise" it, i.e. to split it into words, after eliminating punctuation, and ignoring capital/small or accent difference. A list of words is produced, maintaining the order of appearance in the text. The result of this step may be used, for example, to choose a unique word for synonyms. The second step is to find word sequences with a definite sense.

The algorithm consists in collecting together from two to five words (allowing to choose if also grammar terms, e.g. articles, are to be taken into account) and treating the obtained sets as a unique word. This does not eliminate the need for an inspection of the resulting phrases, but it is of a great help. In addition, the same tool allows comparing two texts, and finding the common sentences with their relative frequency. In our case, this means to individuate the nurse activities that are common to different wards, and those that are specific of the single wards.

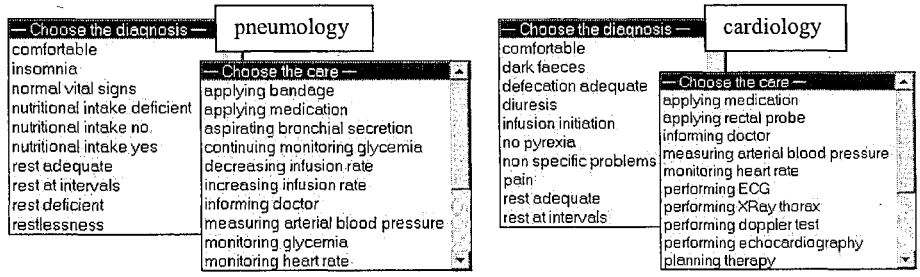

Figure 1: The lists of the most frequent sentences for nurse diagnosis and actions

2.2. *The Text Analysis Results*

The text analysis confirmed the potential benefit of a terminology server. As a matter of fact, two main problems were found in the free text annotations: different sentences with

the same meaning and mixture of phenomena and actions. For example, in the care plan often the diagnosis is reported, as a justification for the annotated treatment. After adjusting for synonyms and wrong positioning of some concepts, we obtained the lists of sentences ordered by their frequency, for both the diagnostic and treatment-related concepts. The lists are different for the two wards, as shown in Figure 1.

3. ICNP within the Electronic Patient Record and Nursing Protocols

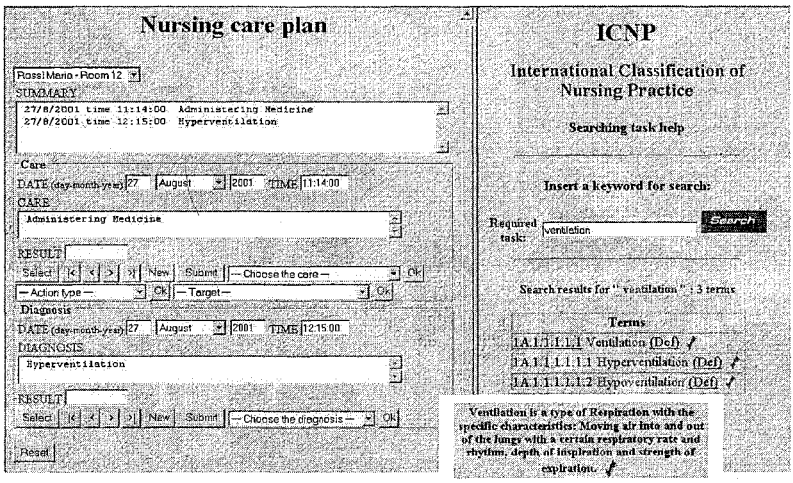

Figure 2: The web-based EPR interface: ICNP browsing facility and the definition of a term

Sharing the same nursing clinical chart among wards is a desire of many healthcare organisations, due to the need of producing comparable statistics and reports about nurse workload through the same hospital. For the two pilot wards, we implemented a web-based interface to a shared EPR relying on a relational Database Management System (Oracle + PL/SQL), and we tailored the interface to each of them. Figure 2 shows the form for the nursing care plan.

According to the nurse that is using the system, when inserting the items for diagnosis and care (fields "Choose the care" and "Choose the diagnosis" in Figure 2), the appropriate window (one of those shown in Figure 1) is presented as a checklist. From there, the nurse is allowed to choose sentences and combine them to build a more complex concept.

In rare cases, when the concept description is not found within the predefined lists, the nurse can look for it browsing the complete ICNP terminology using the right panel of the screen form; she can choose it and also obtain a description of each term. She is allowed to insert free text, but in this case no code will be associated. Anyway, free text is stored for subsequent statistics that could update the list of the "frequent sentences". This could happen, for example, when new treatments are introduced.

Concerning protocols, some years ago we developed GUIDE, a tool for the formal representation of clinical practice guidelines and protocols [4]. Once they have been computerised, guidelines or protocols may be integrated with the EPR to give both decision support in real-time and educational support. An example of such integration is described in [7]. GUIDE adopted a terminology server derived from SNOMED to codify the guideline/protocol actions. Now, in addition to SNOMED, we put ICNP, and we used it for

re-writing an already existing pressure-ulcer prevention guideline and for representing from scratch a protocol for the management of the peripheral venous catheter. The latter is partially shown in Figure 3.

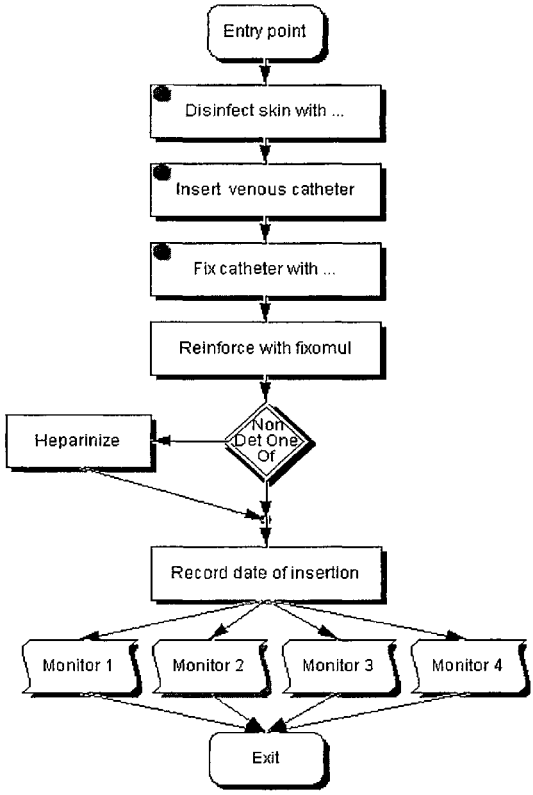

Figure 3: The protocol for the peripheral venous catheter management

4. ICNP Completeness Evaluation

We performed some statistics about actions and diagnoses recorded during the 354 patient-days considered in our study, and about guideline/protocol task names, in relation to the possibility of codifying them using ICNP. A summary of the results is presented in Table 2. In general, it is easier to find ICNP codes for actions than for phenomena. In particular, often it is not possible to codify concept refinement such as colours (e.g. *dark* stool) or site specification for some actions (e.g. assisting the patient at *bathroom*).

Table 2: Percentage of terms that is possible to codify using ICNP

	% phenomena totally codified	% phenomena partially codified	% actions totally codified	% actions partially codified
EPRs	65.38	0.04	80	20
Protocols	50	0	30.77	38.46

5. Conclusion and Future Developments

We showed, through a text analysis of several nursing clinical charts, that there is the absolute need for a standardisation of terminology, if we want to use data for information exchange and reliable statistics. We have proposed a system that allows, as much as possible, to codify nurse inputs into an EPR, without introducing dramatic change in the nurse "reporting style", the system also allows to unify the coding of EPR and guidelines/protocols.

The tool is now at a prototypical level, because there is no official italian version of ICNP yet. Given that it should be delivered within next months, we hope to evaluate it soon in clinical practice.

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