Original Article

Information technologies and nursing process records: case study at a neonatal ICU*

Raphael Brandão Pereira[1], Maria Alice Coelho[2], Maria Márcia Bachion[3]

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[1] Nurse, Master's Degree in Nursing. Nurse at the Nursing School of the Federal University of Goiás (FEN/UFG). Goiânia, Goiás, Brazil. E-mail: raphaelpereira@ufg.br.

[2] Nurse, PhD in Nursing. Nurse at the Hospital das Clínicas of the Federal University of Goiás. Goiânia, Goiás, Brazil. E-mail: malice_coelho@hotmail.com.

[3] Nurse, PhD in Nursing. Full Professor at FEN/UFG. Goiânia, Goiás, Brazil. E-mail: mbachion@gmail.com.

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ABSTRACT

The objective of this study was to analyze the recording of the nursing process, supported by information and communication technologies in both printed and electronic media in the neonatal intensive care scenario. This case study was exclusive, integrated, and conducted between January and April 2014. The study counted on the participation of seven nurses who worked at a neonatal ICU before and after the deployment of new information and communication technologies, which combined electronic and physical (paper) support. Data were collected from medical records and a questionnaire answered by the nurses. Simple and percentage frequency in the levels of the nursing process application were used for analysis, as well as the set of intervening factors related to the work organization structure and process. Positive and negative results were seen, as well as intervening factors. The study concluded that the new information and communication technologies delivered in physical materials accounted for the registration of the higher number of records in the data collection and that the registration of the other stages did not show any substantial improvement.

Descriptors: Nursing Process; Nursing Records; Health Information Systems.

INTRODUCTION

The concern in the nursing area with the adequate use and documentation of the nursing process (NP) is world-wide phenomenon. Considering the complexity of the data to be recorded[1] and based on the premise that tool-based information systems make it easier to record information, nursing professionals

have been seeking to develop NP support software[1-4] and standardized printed materials based on nursing theories.[5-7] However, a study has not yet been conducted on medical records regarding the effect of these information technologies on NP records and their operational stages (data collection, nursing diagnosis, nursing planning, nursing implementation, and nursing assessment).

The objective of this study was to analyze the NP record supported by information and communication technologies in both printed and electronic media in the neonatal intensive care scenario.

METHODS

This case study(8) was exclusive, integrated, and exploratory. It was conducted between January and April 2014. The case in this study was a Neonatal Intensive Care Unit (NICU) at a teaching hospital in Brazil's center-west region. The integrated case units were nurses who had been working in the sector before the deployment of new technologies to support the NP use and recording and continued to work there when the study was conducted.

The NICU had eight beds and physical (paper) medical records were used at the unit. Throughout 2011, new information and communication technologies (NICTs) had been implemented. For this study, we considered a three-month period before (September, October and November 2010) and after (September, October and November 2012) the implementation.

Before the use of NICTs, the recording of the NP application was supported by the following printed forms and files attached to the patients' records:

- Systematics of Nursing Care – standardized form, originally conceived for use at Surgical ICUs (for adults) and adopted by the NICU. Thus, some fields did not apply to neonates' singularities;
- Multi-professional Prescription Form – printed sheet for recording prescriptions by health care professionals with a field for additional nursing notes;
- Evolution Form – for recording neonates' evolution.
- The new information and communication technologies implemented throughout 2011 were:
- Nursing Computerized System (SIEnf, as per its acronym in Portuguese);
- Nursing Documentation Control System (SICODE, as per its acronym in Portuguese);
- Standardized templates of printed forms for registering the collected nursing data specifically about neonates in intensive care.

The SIEnf was a prototype developed by researchers themselves in 2010, using Microsoft® Office Access 2007. The prototype had 15 main requirements (Chart 1).

Chart 1: Nursing Computerized System requirements.

Item	Requirements
1	Registration for an administrator's profile.
2	Patient registration, including identification data and care section.
3	Patient search by name or medical record number.
4	Nursing diagnosis record based on standardized terminologies.
5	Registration of defining characteristics, related factors, and risk factors, by nursing diagnosis.
6	Registration of goals and objectives, by nursing diagnosis.
7	Nursing prescription records, associated with nursing procedures and/or diagnoses.
8	Scheduling records.
9	Automatic finishing of sentences as fields are filled in, based on the last sentences written with the same initial words.
10	Data collection, notes and nursing assessment module fields for free, non-mandatory text for recording additional NP stages.
11	Module for selecting nursing diagnoses from a drop down list, based on standardized terminologies, followed by selection and recording of defining characteristics, related factors, and risk factors from an available list or free text.
12	Module for recording goals and objectives by nursing diagnoses from drop down list based on registration or free text.
13	Module for recording nursing prescriptions from drop down list based on registration (general bank, grouped by diagnosis, or procedures), with scheduling through selection based on appropriate registration or free text.
14	Possibility of creating new records from edition of a previous record duplication related to nursing diagnosis, defining characteristics, related factors, risk factors, goals, objectives, nursing prescriptions and scheduling (impossibility of duplicating data collection, notes, and nursing assessment).
15	Printing of electronic records of NP stages.

After recording information into the SIEnf, the printing of documents was mandatory. Nurses had the choice of not using the software and recording the NP stages into new printed forms and previously existing ones.

The new printed documents used in that scenario were:

- Nursing Admission Form – structured into open fields to record identification, maternal background, pregnancy history, childbirth history, newborn history, nursing diagnosis hypothesis, and conducts;
- Nurse's Physical Examination Form – organized by systems: neurological, respiratory, cardiovascular, gastrointestinal, genitourinary, and tegumentary; with fields to be checked or completed;
- Water-electorlyte Balance, Vital Signs, and Nursing Notes Form – additionally to the neonate's identification, this form had fields for recording vital signs and other biophysical measures every hour; water-electorlyte balance with field for balance calculation every six hours; fields for comments and nursing notes once per shift;
- Nursing Discharge Form – with fields for identifying neonates, followed by blank space for recording a summary of the hospitalization period and conditions upon discharge.

The population was made up of nurses and their respective notes in medical records of patients hospitalized at the studied place. The criterion for including the nurses was having provided direct care at the NICU between September 2010 and November 2012 without being on leave for more than 120 days. Of

the total 13 nurses, seven met the inclusion criterion and became the analysis integrated units. All of them were women; five were specialists; one of them had a master's degree, and one was taking both a specialization and a master's program. Each nurse was identified by codes: U1, U2, U3, U4, U5, U6, and U7.

The record analysis material consisted of notes in printed medical records of hospitalized patients written by the nurses who were part of the study, both before and after the deployment of the NICTs. The inclusion criteria for the records were: referring to the first 72 hours of patients' stay in the NICU, being legible, dated, and signed. An exception was made to prescribed nursing care implementation symbols, which consisted of a diagonal line, without authorship specification.

Excerpts from medical records done by professionals and a questionnaire applied to the nurses were used for data collection.

Nurses' records were transcribed onto digital media. Each sentence or symbol from the notes was entered as a recording unit (RU) and later categorized according to the NP stages by two researchers independently. Identical RU categorizations by researchers were considered "agreements"; whenever that did not occur, they were considered "disagreements" and were discussed until a consensus was reached.

Each hospitalization day was considered as a nursing care day (NCD). The previous phase to the NICTs implementation was comprised of 70 NCD and the subsequent phase totaled 62 NCD. On each NCD, a categorization was made based on the RU as to the level of NP application by means of adapting a previously developed indicator,[9] which started to be used at the institution in 2011 and was called Nursing Process Application Level (NPAL).

The NPAL evidences which NP stages are used simultaneously in nursing care to a particular patient at a particular period, and it is composed of six levels that go from zero (no NP stage recorded) to five (all NP stages recorded) (Chart 2).

Chart 2: Classes of the Nursing Process Application Level.

NPAL			Description
Level 0			No Nursing Process (NP) stage recorded.
Level 1	Sub level	A	Only Data Collection (DC) recorded.
		B	Only Prescription (Pr) recorded.
		C	Only DC and Pr recorded.
Level 2			Only DC, Pr, and Care Implementation (CI) recorded.
Level 3			Only DC, Nursing Diagnosis (ND), Pr, and CI recorded.
Level 4			Only DC, ND, Goal and/or Objectives (G/O), Pr, and CI recorded.
Level 5			Complete NP recorded: DC, ND, G/O, Pr, CI, and Assessment (A)
NA			None of the above.

Source: Adapted from a template used at a teaching hospital in center-west Brazil (2014).

The adjustment done for this study consisted of dividing level 1 into three sub levels: A, B, and C. In case the record did not fall into any of the six levels, it was classified as "None of the above."

For NPAL calculation, the following variables were considered: place (sector, hospital); period (shift, day, hospitalization, month, year); duration (days of nursing care); patient (unitary or multiple); professional

(nurse, nursing group, nursing team); and NP stages followed (DC, ND, G/O, Pr, CI, and Assessment). The equation used is presented below:

$$NPAL\ \textbf{level}\ (n...) = \frac{\sum \text{days applying NPAL}(n...)\text{ in the period}}{\sum \text{NCD in the period}} \times 100$$

Legend:

- NPAL (n...) – Nursing process application level [0, 1A, 1B, 1C...]
- NCD – Nursing care days

The RU counting, their allocation in each NP stage, and the NPAL classification were developed through a computerized system.

The questionnaire used in this study was developed based on the Donabedian model.[10] It consisted of a structured questionnaire, with open- and closed-ended questions on participants' characterization data, nurses' perceptions on the conditions of the scenario and factors that intervened in the NP records. It included questions on the service structure (number of beds; nursing staff size; environmental conditions; equipment, furniture, and input availability; nursing care distribution; trainings on NP, information and communication technologies; and board support for the NP use) and service providing process (nurses' main activities; perception of time availability for applying the NP; and nursing team's commitment to applying the NP). A code was given to each questionnaire to safeguard each subject's identity.

Additional information, including the number of staff, work scale, and their distribution by shifts was obtained from managerial reports.

Data were processed by means of Microsoft® Office Access 2007 and Microsoft® Office Excel 2007. Descriptive statistics was used for analyzing data regarding nursing records, showing the ratio for the RU number for each NCD both in general and in each NP phase, in addition to the NPAL before and after the NICTs deployment, both in general and per nurse. The analysis of intervening factors in the NP records was conducted based on the Donabedian model.[10]

The project was approved by the Research Ethics Committee of the institution where the study was conducted (CAAE protocol no. 24376313.5.0000.5078).

RESULTS

In the period before the NICTs deployment at the NICU, the group of nurses recorded 4,313 RU on 70 NCD, a 61.6 RU/NCD ratio. In the data collection stage, there was the highest number of records (3,864 UR), totaling 55.2 RU/NCD.

After the NICTs, nurses performed 5,391 RU on 62 NCD, totaling 87 RU/NCD. In this period, the data collection stage also prevailed (4,897 RU), totaling 80.4 RU/NCD.

Nursing Process Application Level (NPAL)

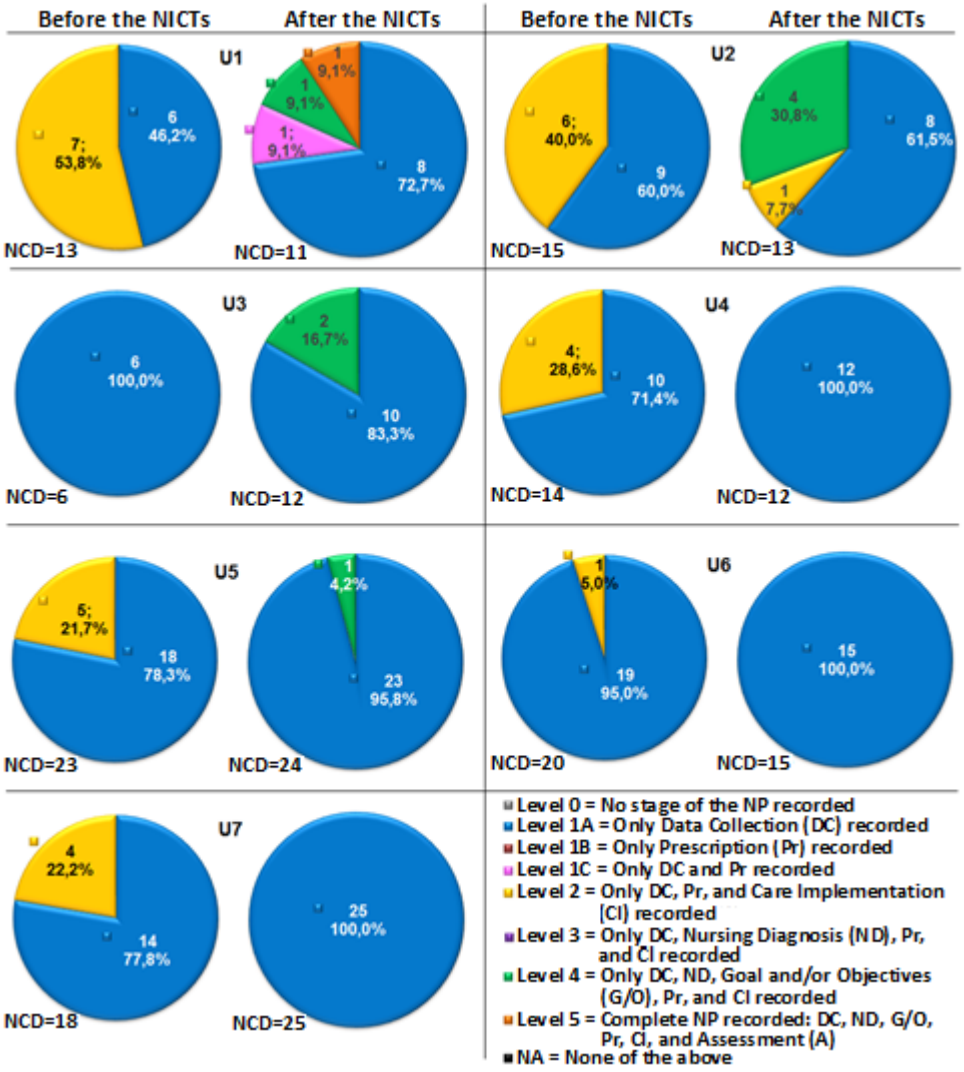
Before the NICTs, NPAL 1A (only data collection) was recorded in 64.3% of the 70 NCD; in the remaining

35.7% (25 NCD), NPAL 2 (data collection, prescription and care implementation) was recorded. There were no records of the additional levels.

After the NICTs, the most elementary NPAL (1A) percentage increased as the number of records in more complete levels decreased. The NPAL quality degree increased, level 4 occurred on seven NCD (11.3%), and level 5 occurred on one NCD (1.6%).

Upon the examination of records, it was possible to verify that in the period before the NICTs, all nurses recorded their data collection and almost all of them (*U1, U2, U4, U5* and *U6*) recorded nursing prescriptions. However, none of them entered diagnoses, goals (objectives), and nursing assessments (Graph 1).

Graph 1: Distribution of nursing process application level per day of care by nurses, according to analysis units, before and after new information and communication technologies at a neonatal ICU. Teaching hospital in center-west Brazil, Sep-Nov 2010 and Sep-Nov 2012.



Legend:

- NCD – Nursing care days
- NP – Nursing process
- NICTs– New communication and information technologies

In the period after the NICTs deployment, nurses *U1, U2* and *U3* recorded other NP stages in addition to data collection and prescription. Nurses *U4, U5, U6* and *U7* limited their records to data collection, failing

to record prescriptions except for nurse U6, who kept not recording nursing prescriptions (Graph 1).

Intervening factors in the nursing process recording

In both periods, the NICU remained with eight beds and located in the same place. After the NICTs, there was a decrease in the average number of nurses on duty from 9 to 8.3. Two of them were working in the morning and afternoon shifts and one worked the night shift. On weekends, there were two nurses in the morning, one in the afternoon and one at night. In the technician and nursing aides team, the decrease was from 37 to 29.7 staff on average.

The nurses told us that their work was supervising the nursing team's actions and performing high complexity procedures (applying bandages, handling tube feeding, PICC, upper airways aspirations, etc.). Regarding the way nurses divided neonates into groups for NP application, it was not possible to identify a clear standard both before and after using NICTs.

As for environmental conditions, nurses listed the following unfavorable factors for NP recording: excess noise, inadequate luminosity, and inadequate workspace. In terms of equipment, furniture, and input availability, they stated that: computers had a poor performance, were in shortage, and located at inadequate places; they were often out of connection with the hospital's main server and that hindered the use of computerized systems; the printers frequently had problems and often lacked ink cartridges; the furniture did not allow for adequate physical posture for recording information on paper records.

The favorable factors mentioned by the nurses were: nurses' adequate knowledge and skill for the care of newborns; having participated in some of the training courses on NP offered by the hospital between 2006 and 2012; having received satisfactory or very good training on NP and SIEnf by expert consultants in Nursing Care Systematization (SAE, as per its acronym in Portuguese); more engagement from the board in the NP application in 2012; having enough time to apply the NP.

Synthesis of the case integrated units

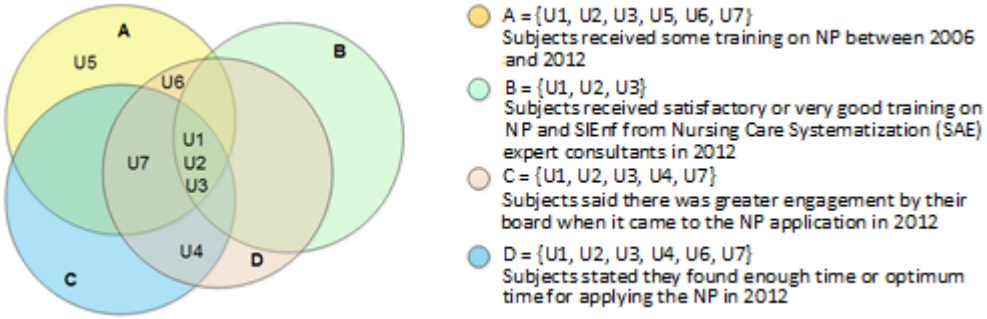
The information given by nurses on the factors that positively interfered with the NP recording regarding service structure, work organization process, and NPAL records profile pointed at different professional groups and intersection areas among them.

- **Group A:** made up of the nurses who stated they had received some kind of NP training between 2006 and 2012 – *U1, U2, U3, U5, U6, and U7*.
- **Group B:** made up of the nurses who said they had received satisfactory or very good training on NP and SIEnf from Nursing Care Systematization (SAE) expert consultants in 2012, and recorded NP into NPAL 3 or above after the NICTs – *U1, U2* and *U3*.
- **Group C:** made up of the nurses who said there was greater engagement by their board when it came to the NP application in 2012 – *U1, U2, U3, U4,* and *U7*.
- **Group D:** made up of the nurses who stated they found enough time or optimum time for applying

the NP in 2012 – *U1, U2, U3, U4,* and *U6*.

It was possible to verify that only nurses *U1, U2* and *U3* were part of all groups and at the same time were the only ones to refer to satisfactory or very good training on the NP and SIEnf (Graph 2).

Chart 2: Grouping of nurses according to positive factors in the use and recording of the nursing process at the neonatal ICU. Teaching hospital in center-west Brazil, 2014.



Legend:

- NP – Nursing process
- SAE – Nursing care systematization
- SIEnf – Nursing computerized system

DISCUSSION

Before and after the NICTs, in 100% of the NCD, data collection was recorded by nurses, showing that neonates had direct contact with these professionals and bringing about the potential for applying the NP. After the NICTs, there was an increase in data collection recording, which shows that the new printed technology adopted and especially structured for neonates favored the record of this stage.

Data collection instruments adjusted for the profile of the clientele cared for and for particular work context can become a facilitating tool. Agile recording protocols are recommended.[6] Scholars in Brazil have been trying to develop instruments based on the Basic Human Needs Theory[5] for use in adult ICUs. No studies have been found in this sense concerning NICUs.

The recording of nursing diagnosis, the establishment of goals and objectives, and the nursing results assessment stages were nonexistent before the NICTs. After the NICTs, these stages began to be performed even though it happened in an incomplete way.

Limiting the use of NP stages, especially the statement of nursing diagnoses, was also a problem identified in other studies in different scenarios.[11]

Before the NICTs, only 35.7% of NCDs included prescription and implementations. In the aftermath, a smaller number of nurses recorded nursing prescription, which shows that these technologies do not help the recording of this stage.

The new computerized technology demanded from nurses to begin the records by filling in the diagnosis name; thus, there should be a mental wording before writing down the record. When registering the diagnosis and prescription, the system offered a number of choices based on certain words that were being recorded. Before writing down the prescription in electronic media, the nurse could search the

prescriptions database for specific diagnoses.

The previous technology consisted of a printed sheet with predetermined prescriptions more commonly used. In the studied scenario, this technology favored the record of this NP stage. However, before the NICTs, nursing diagnoses were not recorded either, implying the possibility that nurses were using care plans instead of the NP per se.

Although spread globally, the NP has not been used widely in the scenarios of clinical practice. In approximately half of handbooks of patients cared for in higher complexity units such as cardiac surgery units, there is only data collection. In the remaining records only one or two additional process phases are recorded, including prescriptions.[11] Regarding NICUs, there are no other available studies mapping NP recordings.

Nurses recognize the importance of NPs for their profession and for their work, to direct the care planning and improve the quality of care for patients in their singularities. Nevertheless, they say their use and recording are difficult to apply.[12-13]

Many difficulties pointed out in literature were not mentioned by the current study's participants such as: insufficient human resources; priority given by nurses to administrative or other activities;[13] lack of organizational culture for using computerized systems to register the nursing care; no acceptance of the NP as a guiding axis for nursing care and fear of handling electronic systems.[14]

The service structural characteristics tend to influence the care giving process, increasing or diminishing its quality degree.[10] It was verified that the size of the nursing team was partly in keeping with the minimum requirement by the law at the time, which stated a minimum number of staff for each ICU shift: one nurse per set of eight beds or fraction and one nursing technician per set of two beds.[15-16]

Most nurses in the studied scenario pointed out that the necessary time for applying and recording the NP was enough before and after the NICTs.

The literature review related to the conduction of this study showed that, in general, research on the time needed for the use of all NP stages is scarce. Specifically in NICUs, no study was found. However, a study estimated that nurses spent 25.58 minutes on recording the NP electronically per adult patient in intensive care.[17] In child and adult intensive care, research identified that the group of professionals spent an average 46.0 minutes per patient/day on electronic records, and 79.9 minutes (1.3 hours) per patient/day on the night shift.[18]

As for difficult factors, system slowness, localization problems and computer accessibility are barriers that hinder the use of electronic recording systems, increase the time needed for documentation and enhance nurses' negative attitude regarding their use.[19-20] Not only do software, equipment, and input issues require investments on the part of health care institutions and managers, but they also call for nurses' participation in developing systems that meet the desirable requirements for their professional activities. The more resources, the easier it will be to implement new work methodologies.[20]

The nursing clinical practice is not a scenario where nurses are available to evaluate patients, make

diagnosis and therapeutic decisions, record their care in an organized and comprehensive way until finishing this meeting and going onto a new activity. In this scenario, nurses' responsibilities are too diverse; they are constantly interrupted and deal with too many demands simultaneously.[13] Therefore, they end up having to choose different priorities.

Considering that the conditions of the studied scenario were relatively stable and the adversities in terms of the local structure had an influence on all nurses, this study assumes that nurses U1, U2, and U3, who began to use a more complete NPAL, did so based on specific factors for their behavioral change regarding their NP records. What they had in common, differently from the others, was their perception of satisfactory or very good training on NP and SIEnf provided by internal consultancy supplied by the SAE area at that institution.

Additionally to investment in intelligent support technologies for recording the clinical practice and inclusion of this item in the management's priorities,[21] the continued educational and training activities among nurses for adequate NP use and the documentation are seen as essential[13,21].

CONCLUSION

The results show that technologies that provide a predetermined information framework for data collection through checklists and predetermined therapeutic decision scripts for nursing prescription seem to favor the recording of NP stages. Unlike what happened in other studies, the time available at the NICU was pointed by the nurses as being enough to record the NP; however, this was not enough for adequate note taking. More complex NPAL application levels still pose a challenge and require well planned, consistent and lasting management policies.

It was possible to verify that nurses, as integrated analysis units, had different characteristics and those who had had access to SAE consulting on the use of the deployed software were more likely to have more advanced levels when recording the NP, showing that this activity seems to be promising to support nurses to record the stages of this process.

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