

Effects of a Computer-based Nursing Documentation System on the Quality of Nursing Documentation

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Abstract Nursing documentation is an important part of clinical documentation. However, documentation of the nursing process is frequently lacking quality. There are high expectations that computer support in nursing documentation will help improve documentation quality. This study aimed to examine whether the introduction of a computer based nursing documentation system can improve documentation quality. A prospective intervention study was conducted on 4 wards of the University Medical Center Heidelberg over a period of 18 months. Two wards in the Psychiatric University Medical Center Heidelberg were involved in the research study, as well as a dermatological and a pediatric ward. The results of the study show a significant improvement of documentation quantity and quality on three of the four wards. Positive aspects include completeness of documentation on the nursing process, formal aspects and subjective quality improvement by the nurses. Negative aspects were mainly associated with the contents of the care plans.

Keywords Quality of nursing documentation · Nursing process · Intervention study · Computer systems

Introduction

The documentation of the nursing process is an important but often neglected part of clinical documentation. Documentation is important for efficient communication within the healthcare professional team and for quality assurance.

Since 1985, due to laws and regulations, nursing training in Germany has been based on the nursing process, thus requiring an adequate documentation of nursing care [1]. Ever since this time paper-based documentation forms allowing the documentation of the nursing process have been available. However, it is commonly found that the nursing process is not integrated into nursing documentation [2–4]. Reasons for the poor implementation are: high documentation efforts, low quality of paper-based records and a limited general acceptance of the nursing process [2, 3, 5, 6].

These problems lead to the attempt to support the nursing process by computer-based systems in order to reduce documentation efforts, increase documentation quality and allow reuse of nursing data for nursing management and nursing research. Problems that have been reported when introducing computers to support nursing are for example a lack of standardized nursing terminology, computer anxious users, fear of less individual care and too much control as well as unclear benefits [7–10].

Another aspect when introducing a new documentation system is the effect on the quality on nursing documentation. Few studies have been conducted comparing documentation quality before and after the introduction of a computer based documentation system [11–13]. Studies auditing nursing documentation have shown that nurses have problems integrating the nursing process into their record keeping [2]. It is unknown whether the introduction of a computer based documentation system may help to

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improve documentation quality. Sahlstedt and Nahm [13] found an increase in documentation quality; Larabee [11] only recorded an increase after re-education of nurses within 18 months.

To find answers to the questions mentioned above, the software PIK® (details in study environment) was implemented on four wards. The effects of a computer based nursing documentation system on the quality of nursing documentation were investigated. Issues of interest when introducing the computer based nursing documentation system were information on factors influencing the acceptance of users on a computer based nursing documentation system and to specifically support nursing documentation. Items concerning nurse's attitude to computers in nursing, to the nursing process as well as the evaluation of the software itself were of interest. They were addressed separately by questioning nursing staff and have been published in Ammenwerth et al. [14].

The aim of this paper is to present and discuss the results of an 18-month prospective intervention study auditing the nursing records on the various wards accompanying the data collection mentioned above. A comparison on differences of documentation quality among the wards was explicitly not desired by nursing management and the staff council. The focus was to identify the development of documentation quality and specific aspects of improvement after implementation of a computer based system.

Study environment and study methods

Study environment

The study was conducted on four wards in three different departments of the University hospital of Heidelberg, Germany (Department of Psychiatry, Department of Pediatrics and Department of Dermatology).

Two of the four wards were selected by the nursing management, the other two wards volunteered to participate in the pilot study. Nursing process documentation was executed quite differently on the four wards before implementing the documentation system: On wards A and B a nursing anamnesis and a care plan were documented in

a paper based form after the patients' admission. Nursing reports were written three times daily, mostly in the ward office. On ward C a short nursing anamnesis was filled in and care planning consisted of documenting planned interventions in every shift as well as writing a nursing report. This was done in the patients' room as well as in the ward office. Ward D also documented a nursing anamnesis and accomplished reduced care planning (containing standardized tasks necessary for staff planning at every shift). The nurse's report was written at least three times daily mostly in the ward office. Table 1 outlines further differences among the study wards.

The software PIK® ("Pflegeinformations-und Kommunikationssystem," which stands for nursing information and communication system) was chosen to support the nursing process. PIK® is developed by a German-wide work-group which supports all phases of the nursing process. When the decision for the project was made in 1997, PIK® was the only software product available in Germany dedicatedly supporting all six phases of the nursing process. Nowadays, other software products are available. PIK®, however, has the most elaborate functionality for nursing process support due to the fact that it was constantly improved by integrating suggestions coming from staff nurses applying the system.

The functionality of PIK® covers the six phases of the nursing care process. It also offers functions for ward management (for example, patient management and use of general forms), for management of the predefined care plans, and for the use of nursing knowledge (such as nursing standards).

PIK® supports the nursing anamnesis by offering flexible forms for data entry. Based on the information gathered in the anamnesis, nursing care plans for an individual patient can be created. To support this, typical nursing problems, outcomes and interventions can be predefined and selected during creation of the care plan. Typical combinations of problems, outcomes and interventions can be combined in predefined nursing care plans. Later, during care planning, these predefined items and standards can be selected and adapted to the patient's individual needs by adding or removing certain items. This makes care planning much easier and more efficient than

Table 1 Characteristics of the four study wards on which a computer-based documentation system was introduced

Unit	Patients' profile	Beds	Number of cases 2000	Mean average of stay	Number of nursing staff	
Ward A	Psychiatry	Acute psychiatric diseases	21	399	20.7 days	19
Ward B	Psychiatry	Acute psychiatric diseases	28	655	13.7 days	17
Ward C	Pediatrics	Children under two years	15	600	4.5 days	13
Ward D	Dermatology	Divers dermatological diseases	20	589	9.6 days	12

conventionally possible. Based on this care plan, nursing interventions are executed and documented on a time axis within the documentation form. Nursing outcomes can be planned, checked and documented and finally nursing reports can be written using free text. Individual nursing reports may be highlighted for other health care professionals.

Data was also collected measuring the attitude of nurses towards computers in general, computers in nursing and the nursing process [14]. The results showed that the average computer experience prior to the introduction of the documentation system varied on the four wards. Approximately half the nurses (20 of 41) estimated themselves as being self-confident or rather self-confident with computers. The main applications used by the nurses in their every day routine in the Clinical Information System are the management system as well as ordering meals, drugs and consumable material, staff scheduling and intra/internet. No experience had been made with a computer-based nursing documentation system. The wards were all equipped with two computers in the ward office and one in an additional staff room.

Prior to the introduction of the nursing documentation system all nurses were trained in small groups and 1–3 motivated nurses were trained as key-users. The other health care professionals (physicians, social workers, co-therapists) received an introduction to PIK® and an own account.

Study methods

A prospective intervention study with three time measurements was applied to receive answers to the quality of nursing documentation. Nursing documents were audited at three different points of time before, during and after implementation of the computer based nursing documentation system as shown in Table 2.

In order to audit the quality of nursing documentation, an instrument was developed which took into account the vast amount of requirements which nursing documentation

needs to consider. Nursing documentation can be regarded as an integral part of clinical documentation which continually documents the professional aspects of the nursing care received.

Nursing documentation needs to fulfill legal aspects concerning documentation as well as specific professional nursing aspects such as documenting the nursing process. These can be summarized according to [15] in the following purposes of nursing documentation:

1. Inner- and interprofessional communication among health care providers to ensure the delivery of safe and effective care as well as to ensure the continuity of good quality of care,
2. Source of data to prove that patient related interventions affect patient outcomes,
3. Evidence of the efficient use of means of care and the assurance of financial reimbursement,
4. Source of legal evidence to testimony nursing quality.

After an extensive literature review on nursing documentation quality and taking into account the legal aspects and recommendations regarding nursing documentation the following relevant quality aspects were detected:

- Sufficient documentation of the nursing process
- Description of the course of care
- Participation of the patient in care planning
- Formal aspects of data entry
- Plausibility
- Value-free documentation

The instrument developed, which is described in Mahler [16], was divided into a quantitative and a qualitative checklist. The quantitative part intended on detecting the effect of a computer based system on the number of documented nursing problems, outcomes and interventions and also scanned documentation according to legal and formal aspects such as nurse's signature, documented time and date. A guideline was used to collect data on qualitative aspects on a five-stepped likert-scale. A preceding randomized study [17, 18] had shown the difficulty in raising

Table 2 Overview of the period of time stipulated for selecting documents to be audited on the four wards

		Ward A	Ward B	Ward C	Ward D
First time measurement (before)	Documentation's audited	June–Aug. 1998	June–Aug. 1999	Mai–July 2000	April–June 2000
Intervention	Implementation of PIK®	Nov. 1998	Nov. 1999	Oct. 2000	Sept. 2000
Second time measurement (during)	Documentation's audited	Feb.–April 1999	Feb.–April 2000	Jan.–March 2001	Dez. 2000–Feb. 2001
3rd time measurement (after)	Documentation's audited	July–Sept. 2000	July–Sept. 2000	June–Aug. 2001	Mai–July 2001

Table 3 Number and type of documentations audited

Time of measurement	Type of documentation	Number of documents
Before	Paper based	4 wards à 20=80
During	Predominantly PIK®	4 wards à 20=80
After	Predominantly PIK®	4 wards à 20=80
		Total 240

objective quality aspects. Most significant results were received in the free textual comments by the auditors and their overall assessment of the documentation.

Study procedure

A total of 240 nursing documentations, 20 at each time measurement from each ward (= 60 documents per ward), were randomly selected from an inpatient registry according to the determined time of measurement as shown in Table 3. This sample was regarded as sufficient considering that at an indicated power of 0.8 shows a difference of one point on a scale between 1–5 can be detected with $\alpha=0.05$.

The only selection criteria to the patient’s record were a minimum of 3 days hospitalization.

The paper based documents (“before”) were copied and de-identified prior to being audited, the computer based documents (“during” and “after”) were audited on the computer screen taking into account the copied and de-identified paper-based parts of the nursing record.

The quantitative data collection was carried out by the study leader. Functionalities in the computer based program

PIK® supported the collection of quantitative data for the PIK® documents.

The qualitative audit of each document was performed by two nursing experts not engaged in the study. To calibrate the evaluation scores, the auditors reviewed the same record separately until agreement on a correct score was reached. This procedure was repeated until consensus was achieved. Each document was audited by both experts.

Analysis

To detect differences in the quantity and quality of the documentation the Kruskal–Wallis-Test was applied on scores, for each ward over the three time measurements. In case of a significant result paired tests were applied with the Wilcoxon–Mann–Whitney-Test. The chi-square test was used to evaluate differences in yes/no items. A probability of 0.05 was regarded as significant. The SPSS for Windows software package was used for statistical analysis.

Results

Aspects of documentation quantity

After the implementation of the computer based documentation system a significant increase of documented problems, outcomes and planed interventions was stated on all four wards at the second time measurement ($p=0.000$) irrespective whether paper based care planning had been conducted prior to implementation or not. The number of executed

Fig. 1 Average number of executed interventions for one patient on 1 day on the four pilot wards before introducing PIK® (time 1), 3 months (time 2) and 9–20 months (time 3) after introducing PIK®

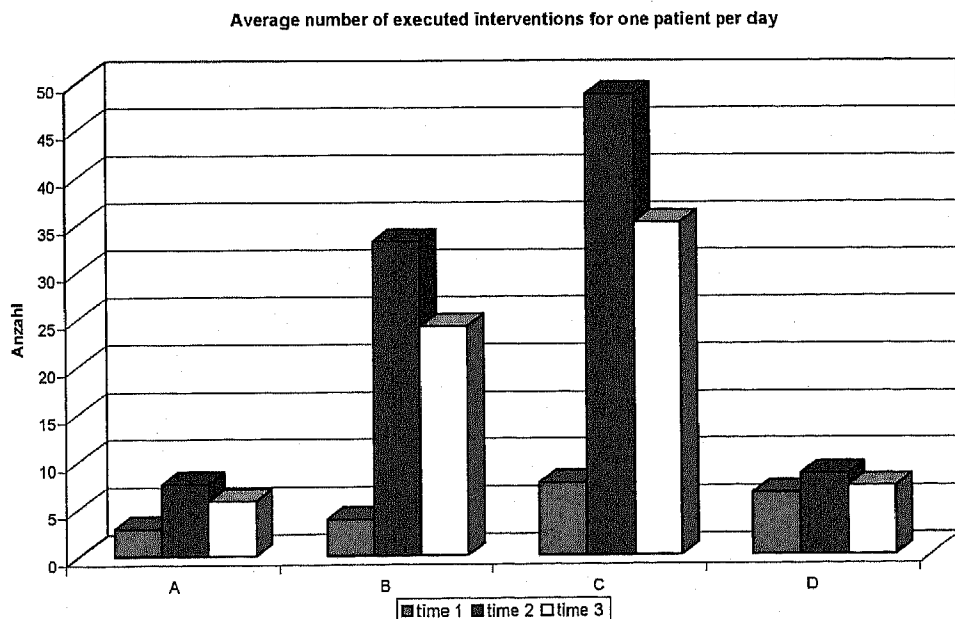
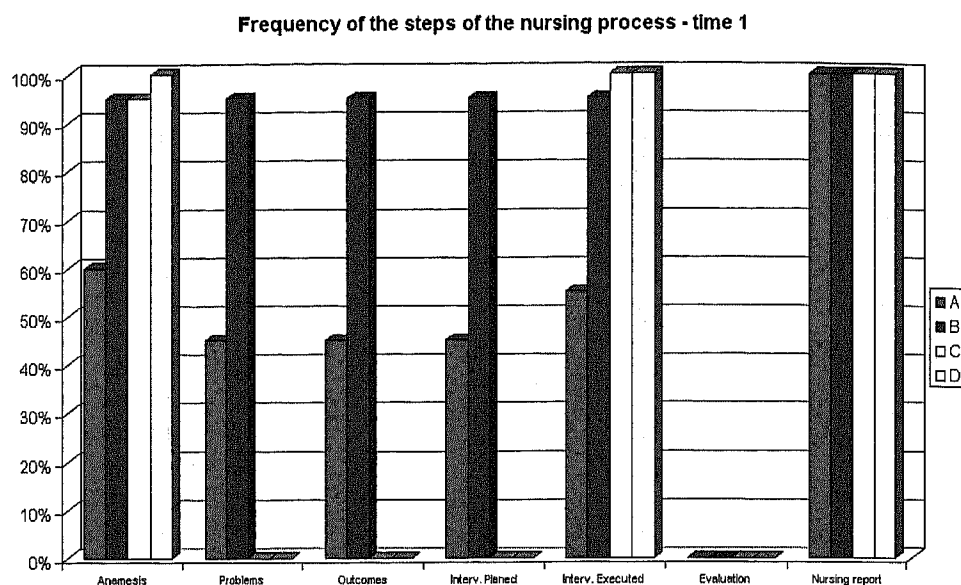


Fig. 2 Percentage of documents showing the steps of the nursing process as analyzed in 20 documents on the four wards (= 80 documents analyzed) before implementing PIK®. No distinct form existed to document the evaluation of care



interventions documented also increased significantly on three of the four wards ($p \leq 0.004$) thus leading to more transparency of nursing care delivered (see Fig. 1).

We found that conventional care plans were rarely modified during a patients stay whereas after the implementation of PIK® the care plans were altered notably more frequently ($p \leq 0.002$).

Aspects on documentation quality

Sufficient documentation of the nursing process

Nine months after the introduction of PIK®, not all steps of the nursing process were being documented on all wards. However, care plans could be found everywhere and other

parts of the nursing process were being documented more frequently (see Figs. 2 and 3). PIK® therefore seems to be suitable for representing formal aspects of the nursing process. As shown in Fig. 2 conventional care planning was only found on two wards before the introduction of a computer based system; on one of the wards however only among about 45% of the nursing records. Figures 2 and 3 show the frequency of the steps of the nursing process as they were found in the 20 documents audited on the four wards at time 1 and time 3.

Description of the course of care

Due to the higher sufficiency of the nursing process documentation in PIK® (see Fig. 3), the auditors stated a

Fig. 3 Percentage of documents showing the steps of the nursing process as analyzed in 20 documents on the four wards (= 80 documents analyzed) 9–20 months after implementing PIK®

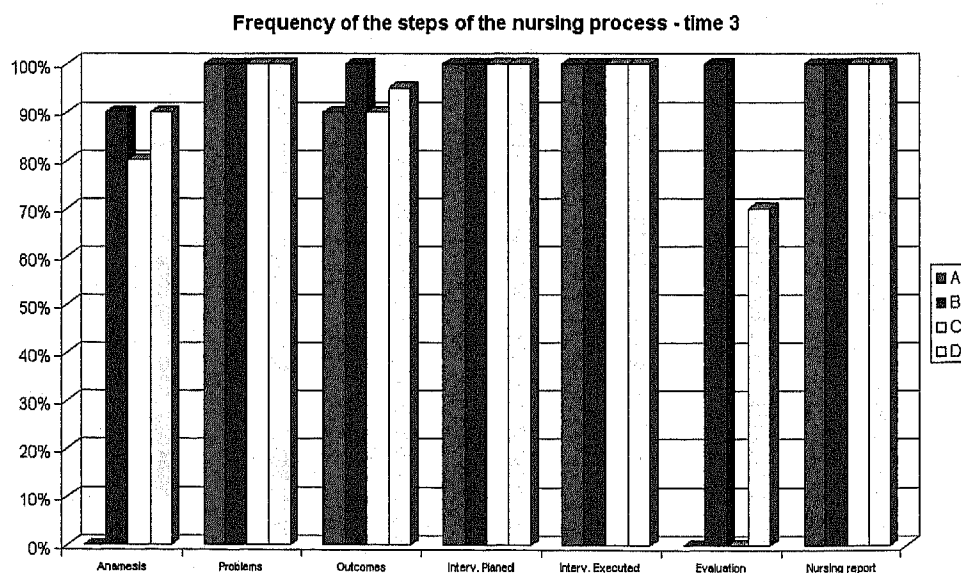
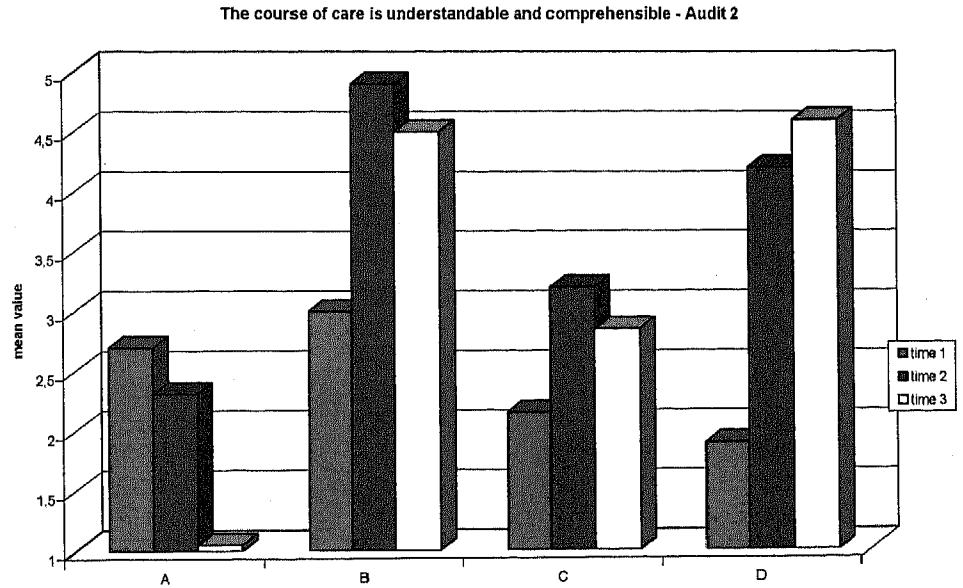


Fig. 4 Result of auditor 2 to the item of the checklist “The course of care is understandable and comprehensible” (scale 1 to 5, 1=no, 5=yes)—3 months before (time 1) implementation of PIK®, 3 months (time 2) and 9–20 months (time 3) after implementation of PIK®



better overview of nursing care. The evaluation of care in particular leads to a reflection and revision of care planning. Three months after the introduction of PIK® the understandability and comprehensiveness of nursing documentation had increased significantly on three of the four wards ($p=0.000$) (see Fig. 4). Points of criticism by the auditors were the lack of adaptation of care plans to the patient’s needs and the fact, that problems which had been mentioned in detail in the nursing report over a period of time did not appear in the care plan. It seemed as if the standardized care plans were applied non-reflectively, especially during the first few months after the implementation of PIK®.

Participation of patients in care planning

The auditors stated, that both in conventional and computer based documentation there was no evidence for the participation of the patients in care planning.

Formal aspects of data entry

Due to legal regulations nursing documentation needs to fulfill formal requirements. After the implementation of PIK®, dating and signing of care plans and nursing reports increased significantly on all wards ($p=0.000$), due to the

Fig. 5 Result of auditor 1 to the item of the checklist “How would you summarize the quality of this documentation?” (Scale 1 to 5, 1=bad, 5=good) —3 months before (time 1) implementation of PIK®, 3 months (time 2) and 9–20 months (time 3) after implementation of PIK®. $N(240)=4$ wards \times 3 audits \times 20 documents

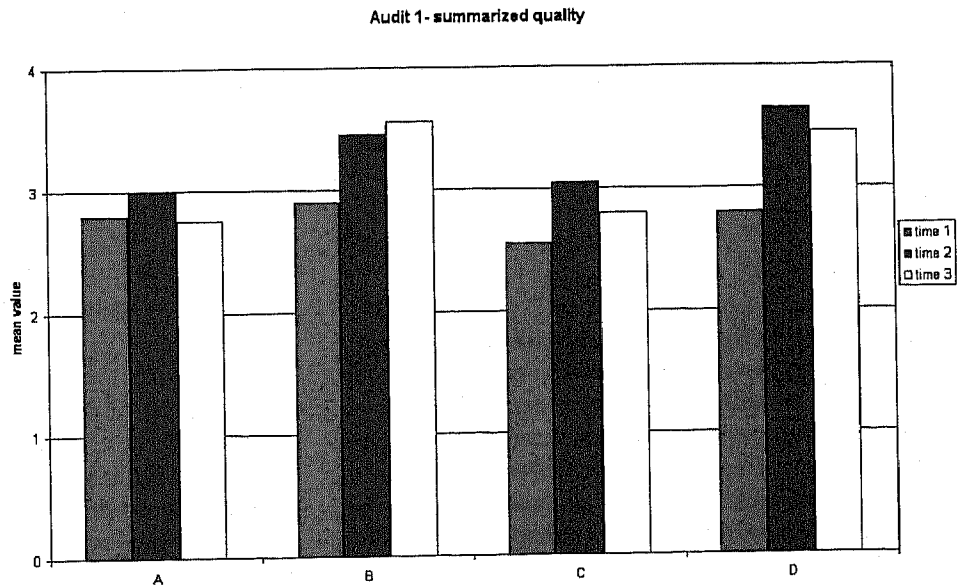
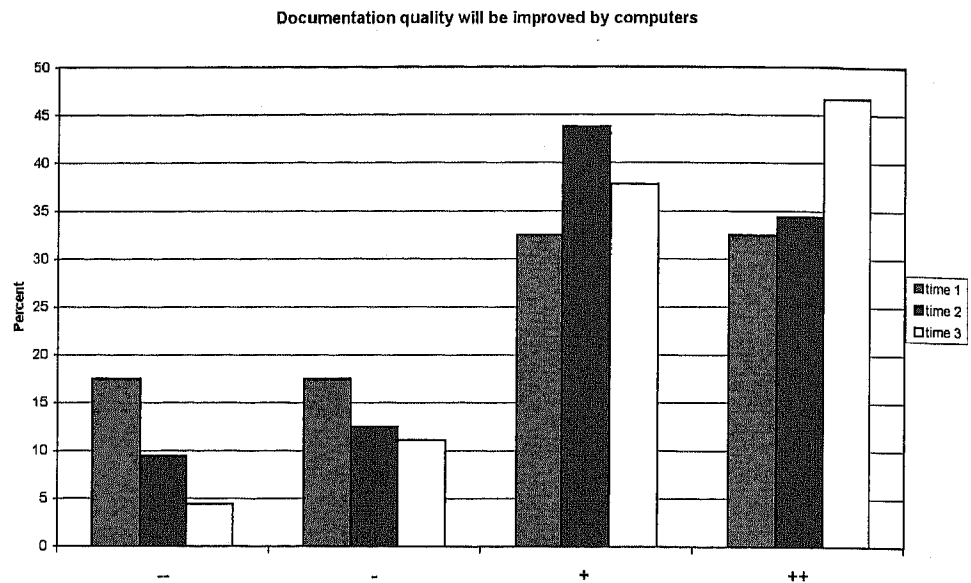


Fig. 6 Item “The quality of nursing documentation will be improved through the use of computerized care plans.” Nurses on 3 pilot wards answered the questionnaire at all three time points ($n=40$; 32; 45)—3 months before (time 1) implementation of PIK®, 3 months (time 2) and 9–20 months (time 3) after implementation of PIK®



fact that each nurse was logged in with her own password and each data entry was dated automatically.

Plausibility

On two of the wards auditors stated that at time 3, despite care planning, the intention of nursing care did not seem to be evident. The lack of a theoretical framework for nursing care while introducing the nursing process may be an explanation for this phenomenon.

Value-free documentation

An important qualitative aspect of documentation is the objective presentation of occurrences. The auditors scanned the documents on slang expressions or phrases negative connotations. Only few interpretative entries were found in the conventional documentation. After the implementation of PIK® hardly any were found at all. Reason for this trend may be the fact that nurses expressed that due to higher legibility they gave more thought to their entry in the nurse's report.

Overall assessment

The results of this study show, that after the introduction of a computer based nursing documentation system the quality of nursing documentation improved as stated by both auditors in their overall assessment of the documentation. Further quality improvement at time 3 (9–20 months after implementation) could not be attested. A significant quality increase was found on three of the four wards between time 1 and time 3 ($p \leq 0.002$). One ward showed no quality

improvement. The results of the overall quality assessment of auditor 1 are shown in Fig. 5.

Subjective quality improvement

The introduction of PIK® required an intensive discussion among the nurses regarding documentation in general as well as on the nursing process. Standardized care plans needed to be developed and daily organizational processes had to be reorganized. The reflection on documentation practice enabled the nurses to find new possibilities in improving their documentation.

Questionnaires, which were handed out to nurses at all three points of time, collected data on the nurses subjective opinion regarding the quality of computer based nursing documentation among many other aspects. As shown in Fig. 6, two thirds of the nurses expected a quality improvement by computer support before the introduction of PIK®. This expectation is topped 3 months afterwards and rises once again at time 3. PIK® seems to live up to the expectations of the nurses, which is also expressed in the interviews. Nurses see the quality improvement to be confirmed by the higher transparency of delivered care in the documentation. Further information on the results of the questionnaires are published in [14].

Discussion

First of all, the methods applied should be discussed and some limitations of the study should be pointed out: In order to obtain validity, the checklist was developed together with two nursing experts on the basis of literature.

Furthermore, the results of the questionnaire regarding the quality of the documentation correspond to the results received by the auditors and confirm criteria validity.

Due to a prior study [18], we decided on using an overall quality assessment as critical quality criteria. The overall quality assessment proved to be the best indicator for documentation quality. In our study design, we decided on collecting quality data of each document by two independent auditors. The reason for this decision was the fact that the prior study showed difficulties in raising an objective quality assessment. The differences in the evaluation of both auditors confirmed this assumption and show limitations in the reliability of the instrument. Both evaluation results, however, give the same direction in quality movement and are due to different emphasis in the assessment by the auditors as mentioned later on in interviews conducted with them on the audit process. The assessments for each auditor were therefore analyzed separately.

Having conducted an intervention study with no control ward, we cannot attest a causal relationship between the implementation of PIK[®] and the quality improvement of nursing documentation, as no audits were conducted on a comparison ward with paper based documentation over the long term period. Other factors such as the intensive discussion on nursing documentation, changes in documentation system, turnover rate of nurses and their attitudes towards documentation may also have led to the overall quality improvement.

Our results show, that the computer based nursing documentation system enabled nurses to easily document nursing interventions, showing in detail the work they perform daily and making nursing care transparent. This aspect was appreciated very much and emphasized by the nurses in the interviews which were conducted. Acceptance scores of PIK[®] in questionnaires also validate these results [14]. According to conventional and computer based documentation records nurses in our study rarely seem to involve patients in the process of care planning. These findings are similar to other studies also stating the lack of patient involvement in care planning in nursing documentation [2, 4]. The subjective opinion of nurses on improvement of documentation quality is an important aspect for staff motivation to continue documenting the nursing process in the computer based system. Nurses may seem to see their documentation efforts acknowledged.

Audit studies have described that conventional paper based documentation often do not come to terms with legal documentation requirements [4]. We found that due to the introduction of PIK[®] and the automatic documentation of the person performing the documentation, formal requirements were fulfilled in all computer based documentations. This is an important improvement especially for nursing and hospital management when facing forensic problems.

The results did not show an improvement in documentation quality on all wards. The overall documentation quality decreased slightly on Ward A 20 months after implementation of the computer based documentation system (see Fig. 5). Taking into account the difficulties in supporting this ward during the long term project, we conclude that computer support itself does not necessarily lead to a quality improvement. Leadership issues and fluctuation of nursing staff were aspects which we assume had influence on documentation quality. The different developments on the four wards indicate that the allocation of an appropriate tool does not improve documentation quality automatically and further problems can arise. Without continuous support, improvement is hard to achieve and maintain.

These results are in line with others showing that introduction of computer based documentation does not necessarily directly lead to quality improvement [11]. Supportive training programs combined with organizational changes, however, have shown to improve nursing documentation [19].

Another critical aspect was the non-reflective use of standardized care plans. On two wards the intention of care planning was not evident to the auditors at time 3. Theoretical framework may be of help to overcome this problem when introducing the nursing process. The easy documentation and creation of care plans led to a vast amount of problems, outcomes and interventions which weren't always adapted to the patients needs. Higher transparency of delivered care was appreciated by nurses; however a large number of interventions that were planned were not executed at the same time. The computer based documentation system enabled the quick documentation of every single nursing intervention, not only in form of check-marking routine care as in paper based documentation. This led to an increase of time needed for documentation, especially on the pediatric ward, where routine care (for ex. feeding, changing nappies) is performed day and night and to an increase in the size of the nursing documentation.

Conclusion

The results show that the introduction of a computer based nursing documentation system can help improve the documentation of the nursing process and fulfill legal requirements for documentation. However, further problems can emerge and these need to be considered. In order to improve documentation quality, nurses not only need to be supported in the application of the software but also in implementing nursing concepts and applying the nursing process. Human factors and specific ward settings need to

be taken into account and analyzed beforehand, for a successful long-term implementation and long-term quality improvement.

In order to minimize problems and negative effects arising by computer based documentation, we suggest that continuous and sufficient support in applying the software and attendant training programs in the nursing process should not only be planned during the implementation phase but also in the routine application of the nursing documentation system.

Following these results in depth qualitative interviews were conducted 2002 and a theory of FITT (Fit between Individuals, Task and Technology) was developed revealing that the interaction of task, technology and individual need to be considered for successful IT-adoption [20]. The quality of nursing documentation is therefore influenced not only by human factors such as motivational aspects and nurses' attitudes towards documentation. Organizational issues in the hospital environment as well technological aspects concerning performance and task fulfillment are also relevant to IT-adoption and quality improvement. All these aspects interact with one another and play an important role in the development of documentation quality. Interventions to improve documentation quality therefore need to be planned continuously and are a constant challenge.

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