MEDINFO 2001
V. Patel et al. (Eds)
Amsterdam: IOS Press

Systematic Evaluation of Computer-Based Nursing Documentation

Elske Ammenwerth[a], Ansgar Kutscha[b], Ronald Eichstädter[c], Reinhold Haux[a]

[a] *Dept. of Medical Informatics, University Hospitals of Heidelberg, Germany*

[b] *Dept. of Paediatrics, University Hospitals of Heidelberg, Germany*

[c] *Dept. of Psychiatry, University Hospitals of Heidelberg, Germany*

Abstract

The documentation of the nursing process is an important, but often neglected part of clinical documentation. Paper-based systems have been introduced to support nursing process documentation. Frequently, however, problems, such as low quality, are reported and it is still unclear if computer-based documentation systems can reduce these problems.

We therefore introduced a computer-based nursing documentation system on four wards of the University Hospitals of Heidelberg. We systematically evaluated its preconditions and its effects in a pre-test post-test intervention study. We combined objective data (e.g., based on quality checklists) with subjective data drawn from questionnaires and interviews. In this paper, we present preliminary results, focussing on detailed results from the first two wards.

Keywords:

Nursing process, Computer-based Nursing documentation, Nursing Documentation Systems, Evaluation, User acceptance, Documentation Quality

Introduction

Nursing documentation is one important part of clinical documentation. A thorough nursing documentation is a precondition for good patient care and for efficient communication and co-operation within the health professional team.

Nursing care is usually oriented towards the so-called nursing process. The nursing process provides a systematic methodology for nursing practice. It consists of six phases: 1. Assessment of relevant information; 2. Definition of problems and resources of the patient; 3. Derivation of nursing aims, 4. Planning of nursing tasks; 5. Execution and documentation of these tasks; 6. Evaluation of nursing care and possibly redefinition of the care plan.

Paper-based systems have been introduced to support nursing process documentation. Frequently, however, high investments in documentation efforts, low quality and limited general acceptance of the nursing process (e.g., [1]) are reported.

There have been many attempts to support the nursing process using computer-based documentation systems, but despite high investments, it remains unclear if computer-based documentation systems can solve the mentioned problems, reduce documentation efforts and increase the acceptance and quality of nursing process documentation. There have been studies evaluating the effects of computer-based nursing documentation (e.g., [2], [3], [4], [5]), but none focused on supporting all six phases of the nursing care process, nor do they take both quality of the documentation and user acceptance into account.

We therefore decided to systematically evaluate the preconditions and consequences of computer-based nursing process documentation at the Heidelberg University Hospitals. We chose three different psychiatric and somatic departments and conducted a pre-test post-test intervention study on four wards.

The preliminary results of the evaluation of the first pilot ward have already been published ([6], [7]). Among other aspects, a significantly higher acceptance of computers in nursing and of the nursing process were found upon introduction of computer support, and also, an improved quality of nursing process documentation was achieved.

The aim of this contribution is now to present further results of the evaluation (mainly from two of the four wards) and to discuss factors leading to a successful introduction of nursing documentation systems.

Study Design

The overall aim of the study was to evaluate the preconditions and consequences of computer-based nursing process documentation. The software PIK ("Pflegeinformations- und Kommunikationssystem") was chosen for the study and introduced on four wards of three different departments (Department of Psychiatry, Department of Paediatrics, and Department of Dermatology) of the University Hospitals of Heidelberg, Germany. PIK was developed by a Germany-wide work-group, thus enabling us to participate in its development. PIK fully supports all phases of the nursing process.

Study aims

The aim of our study was to answer the following major questions:

Q1: How does user-acceptance of the nursing process, of computers in general and of computers in nursing change during the introduction of a computer-based nursing documentation system?

Q2: How is the user-acceptance of the computer-based nursing documentation system following its introduction?

Q3: How does the quality of nursing process documentation change during and after the introduction of the computer-based nursing documentation system?

Q4: How are the acceptance scores of Q1 correlated to the acceptance scores of Q2?

Methods

We used an intervention study with three time measurements:

- approx. 4 months before introduction ("before")
- approx. 4 months after introduction ("during")
- approx. 12 months after introduction ("after").

The intervention was defined by the introduction of the nursing process documentation system PIK on the entire ward for all phases of the nursing care process. The study period lay between August 1998 (pre-test on the first ward) and October 2001 (post-test on the last ward).

We used a mix of quantitative and qualitative methods to answer the questions of interest, including questionnaires, interviews, and quality checklists.

To answer Q1 and Q2, we selected validated questionnaires (based on [8], [9], [10]) which were answered by all nurses before, during and after the introduction. The resulting acceptance scores were then compared using statistical analysis procedures. In addition, we interviewed nurses from each ward to discuss our findings and to assess their overall judgement.

To answer Q3, we constructed a quality checklist based on an extensive literature review, which was to be used by two external nursing experts to observe different aspects of quality of all nursing documentations before, during and after the introduction of the computer-based documentation system. To answer Q4, using Spearman's correlation index, we correlated the acceptance scores measured before the introduction with the acceptance scores and quality measurements found during and after the introduction.

Course of the study

The computer-based nursing process documentation system PIK was introduced on the four study wards

- in November 1998 on ward A (Dept. of Psychiatry, 21 beds, 12 nurses)
- in November 1999 on ward B (Dept. of Psychiatry, 28 beds, 18 nurses)
- in September 2000 on ward C (Dept. of Paediatrics, 15 beds, 13 nurses)
- and in October 2000 on ward D (Dept. of Dermatology, 20 beds, 12 nurses).

On each ward, the software was installed on at least three health professional workstations, and, in addition, on the workstations of other health care professionals (doctors, therapists, etc.).

Before the introduction, all nurses received between two and three hours of training on the documentation system. The other professionals received a short introduction. To achieve data integration and to enable exchange of administrative patient data, the software was interfaced with the communication server of the Heidelberg Hospital Information System.

We then conducted the study according to the study plan. Overall, approx. 70 nurses, who worked with the nursing documentation system during the three years of the study, answered the questionnaire. Approx. 1600 patients were documented. The return ratio of the questionnaires was between 75 - 80% (depending on time point and ward).

Results

On wards A and B, the nursing care process had been established for several years. In contrast, on ward C and D, the phases 1 - 3 of the process have not been documented. Some of the nurses had prior computer experience (approx. half of the nurses stated being self-confident or rather self-confident with computers), but none had worked with computer-supported nursing documentation systems before the study. At the beginning of the study, 20 of the 41 nurses of the study wards were younger than 29, 11 were between 30 and 39, and 10 were older than 39.

Q1: How does user-acceptance of the nursing process, of computers in general and of computers in nursing

change during the introduction of a computer-based nursing documentation system?

Acceptance of nursing process

Based on the 18 items of the questionnaire used ([8]), a mean acceptance score for each nurse was calculated (1 = minimum, 4 = maximum acceptance). The means of the acceptance scores were significantly different between the wards before the introduction of the computer-based documentation system (Kruskal-Wallis-Test, $p<0,01$; figure 1 shows mean and standard deviation).

When data from both during and after introduction is available, we will test if there is a significant change during the introduction of the computer-based system. Preliminary results from ward A indicates that there may be a significant change in this acceptance score. The data from ward B, C and D will be used to complete this analysis.

Acceptance of computers in general

Based on the 19 items of the used questionnaire ([9]), a mean acceptance score was calculated for each nurse (1 = minimum, 4 = maximum acceptance). Figure 1 shows the results before the introduction of the computer-based documentation system.

Acceptance of computers in nursing

Based on the 9 items of the questionnaire used ([10]), a mean acceptance score was calculated for each nurse (1 = minimum, 4 = maximum acceptance). Figure 1 shows the means and standard deviations of the acceptance scores before the introduction of the computer-based documentation system.

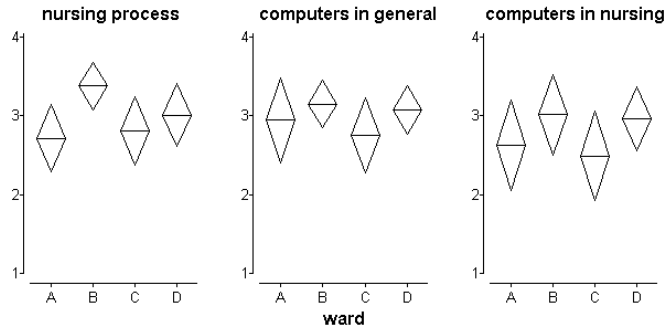

Figure 1: *Means and standard deviations of acceptance scores (N= 11 (ward A), 9 (B), 10 (C), 11 (D))*

Correlation between acceptance scores

Using Spearman's correlation index, we analysed the correlation between the different acceptance scores of the data before introduction. The preliminary results point out a correlation between acceptance of the nursing process and of computers in nursing, also, they show a correlation between computers in general and computers in nursing.

Q2: How is the user-acceptance of the nursing documentation system following its introduction?

Preliminary results from wards A and B show a high acceptance of the computer-based nursing documentation system. All 20 nurses of the wards, who responded to the questionnaire one year after introduction, felt competent (n=10) or rather competent (n=10) when working with the software.

The nurses mentioned that the computer-based documentation system leads to a better legibility (19 of 20 nurses), to a better overview of the nursing care (19/20), to a higher completeness (18/20) and to an improved quality of documentation (19/20). They judged the computer-support as useful for care planning (18/19), for planning and documentation of tasks (15/19) and for writing nursing reports (17/19). They saw some time savings during care planning (16/20) and also partly during planning and documentation of tasks (13/20) and during report writing (14/20).

The overall judgement of the software PIK on ward A and B one year after introduction is rather high (about 3.3 on a scale from 1 to 4). 19 out of 20 nurses want to continue working with PIK.

The functionality and user friendliness of the software increased during the study, due to the continuing feedback of the users. For example, in 1999, on ward A, the user friendliness was judged 2.8 (with 1 = minimum, 4 = maximum; n=11), whereas in 2000, the user friendliness was judged 3.4 (n=7). On ward B, in 2000, the user friendliness was also judged 3.4 (n=13)

Q3: How does the quality of nursing process documentation change during and after the introduction of the computer-based nursing documentation system?

The quality measurements are just under way.

During the three time points (before, during and after introduction), 20 documentations are randomly chosen from each ward and their quality evaluated. Overall, 240 documentations will be analysed (20 x 4 wards x 3 time points) by two external nursing experts using a pre-tested quality checklist which combines quantitative and qualitative aspects of nursing process documentation quality.

The following presents the preliminary results of a pre-test of 60 nursing documentations on ward A during the introduction of PIK, comparing paper-based documentation and computer-based documentation: Examination of the documentations showed that 79.3% of the computer-based documentations were complete while only 50% of the paper-based documentations were so. The paper-based care plans contained on average 3.5 problems, 3.3 aims and 3.8 tasks. The computer-based care plans contained on average 5.6 problems, 11.3 aims and 18.7 tasks. In 20% of the computer-based, and in none of the paper-based documentations, tasks were planned but not executed. 34.7% of the paper-based documentations had items not

correctly signed by a nurse. All computer-based documentations were judged legible, while only 14.2% of the paper-based documentations were considered so.

Overall, the external nursing experts judged the quality of paper-based and computer-based documentation of ward A as equal (score from 1 = min to 5 = max; computer-based group: mean = 2.4; paper-based group: mean = 2.3). Nevertheless, they identified quality differences concerning the following aspects: During the introduction phase, computer-based care plans were often considered as too unspecific and too long, leading to less individualised care and too many planned but not executed tasks. In the paper-based documentation, they mainly criticised the often incomplete nursing documentation, illegibility and missing signatures. In the interviews, both nursing experts mentioned that a revision of the pre-defined care plans in the computer-based system and an increased sensitivity of the nurses for the necessity of individualisation of these pre-defined plans could lead to a quality improvement in the computer-based documentation.

Q4: How are the acceptance scores of Q1 correlated to the acceptance scores of Q2?

We are interested in factors leading to a successful introduction of a computer-based nursing documentation system. Possible factors are: acceptance of the nursing process, acceptance of computers in general, acceptance of computers in nursing, amount of software training, organisation of introduction and support, amount of functionality and user friendliness of the software.

To analyse the importance of the different acceptance scores, we correlated the acceptance of the nursing care process, of computers in general and of computers in nursing with the overall software acceptance. We could see that on wards A and B, the acceptance of nursing process before the study was positively correlated to the acceptance of PIK after one year of use, indicating that the acceptance of nursing process may be one success factor. The acceptance of computers in general or computers in nursing before the introduction seems not to be correlated to the acceptance of the nursing documentation software.

The amount of software training and the organisation of introduction and support was similar between the four wards. The acceptance of the software after one year was also quite similar between wards A and B. These and the others factors will be carefully examined and analysed when the results from wards C and D are available.

Discussion

We have presented preliminary results of the systematic, long-term evaluation of a computer-based nursing documentation system on four wards of three departments of the University Hospitals of Heidelberg, Germany. Final results will be available at the end of 2001. We focused on questions of user acceptance and quality of documentation. We evaluated user acceptance because human factors play an important role in the success of information systems ([11]). We did not try to measure effects on quality outcome, we concentrated on questions which could be answered in a limited amount of time.

We found a significant difference in the acceptance of the nursing care process on the different wards at the beginning of the study, which reflects the different use of the nursing process on the wards. The acceptance of computers in nursing was correlated to the acceptance of computers in general. In addition, the acceptance of computers in nursing was correlated to the acceptance of the nursing care process.

Despite the different acceptance scores at the beginning of the study, the computer-supported documentation system was introduced successfully on all four wards. The user acceptance of the documentation is quite high. In the opinion of the users, the documentation system reduces time efforts, increases the quality of documentation and is easy to use. When answering Q3, we will see if this subjective evaluation matches the objective evaluations of the quality of documentation.

A first analysis of success factors shows that the acceptance of the nursing process is positively correlated to the acceptance of the computer-based documentation system. We also saw that on ward A, the acceptance of the nursing process was significantly higher after one year of using the computer system. This means that the introduction may be easier when a high acceptance of the nursing process can be found at the beginning. But, nevertheless, the acceptance of computer-based documentation will increase, as will the understanding of the nursing care process. This will be analysed in detail when complete data is available.

We will then focus on differences between the four wards, and on long-term effects of computer-based nursing documentation. When comparing the wards, we will thoroughly take differences in starting conditions into account, such how the wards were motivated for the projects, which version of the software was introduced, and how the overall support and project management was organised. Although a randomisation would have been better, it was not useful due to the limited amount of wards available.

It must be examined if our results are transferable to other departments and to other documentation systems. The study design and the study instruments can be reused in other surroundings, and the results can then be compared between different settings, leading to a more global view of the effects of computer-based nursing process documentation.

Conclusion

In our opinion, the introduction of a new computer-based application system should be preceded and accompanied by

evaluation studies. Without systematic studies, the experiences about preconditions and effects cannot be sensibly reused. Such a study should encompass evaluation of objective data (such as changes in quality, time effort, costs, and errors), but also subjective data (such as user evaluation).

Acknowledgements

Such a long-term project is not possible without the help of many people. We wish to thank Friedrich Fellhauer, Torsten Happek, Bettina Hoppe, Marianne Kandert, Gisela Luther, Cornelia Mahler, Ulrike Pohl, Simone Rebel and Regina Spieß-Holusa for their co-operation.

References

[1] Varcoe C. Disparagement of the nursing process: the new dogma? *J Adv Nurs* 1996: 23(1) pp 120-125.

[2] Hanisch P, Honan S, and Torkelson R. Quality improvement approach to nursing care planning: implementing practical computerized standards. *J Healthc Qual* 1993: 15(5) pp 6-12.

[3] Keller L, McDermott S, and Alt-White A. Effects of Computerized Nurse Careplanning on Selected Health Care Effectiveness Measures. In: *15th Annual Symposium on Computer Applications in Healthcare*. New York: McGraw-Hill, 1992; pp. 38-41.

[4] Newton C. A Decision Support Database for Nurse Care Planning As Part of a Hospital Information System. In: Greenes R, Peterson H, and Protti D, eds. *Medinfo 95 - Proceedings of the 8th World Congress on Medical Informatics*. Amsterdam: North Holland, 1995; pp. 1394-8.

[5] Sahlstedt S, Adolfsson H, Ehnfors M, and Källström B. Nursing Process Documentation - Effects on Workload and Quality when using a Computer Program and a Key Word Model for Nursing Documentation. In: Gerdin U, Tallberg M, and Wainwright P, eds. *Nursing Informatics - The Impact of Nursing Knowledge on Heatlh Care Informatics*. Amsterdam: IOS Press, 1997; pp. 330-336.

[6] Ammenwerth E, Eichstädter R, Haux R, Pohl U, Rebel S, and Ziegler S. A Randomized Evaluation of a Computer-Based Nursing Documentation Systems: Meth Inform Med 2001: 40 (2). Just being published.

[7] Ammenwerth E, Eichstädter R, Kochenburger L, Pohl U, Rebel S, and Haux R. Systematic evaluation of computer-based nursing documentation system. In: Victor N, Blettner M, Edler L, Haux R, Knaup P, Pritsch M, Wahrendorf J, Windeler J, and Ziegler S, eds. *Medical Informatics, Biostatistics and Epidemiology for Efficient Health Care and Medical Research - Contributions from the 44th Annual Conference of the GMDS, Heidelberg*. München: Urban und Vogel, 1999; pp. 286-290.

[8] Bowman G, Thompson D, and Sutton T. Nurses' attitudes towards the nursing process. *J Adv Nurs* 1983: 8(2) pp 125-129.

[9] Nickell G, and Pinto J. The Computer Attitude Scale. *Comp Human Behav* 1986: 2 pp 301-306.

[10] Lowry C. Nurses' attitudes toward computerised care plans in intensive care. Part 2. *Nurs Crit Care* 1994: 10 pp 2-11.

[11] Montserrat M-B, Planas I, Palau J, Montserrat M, Sancho JJ, and Sanz F. Assessing Physician's Expectations and Attitudes Toward Hospital Information Systems - The IMASIS Experience. *M.D.Computing* 1999: Jan./Febr. 1999 pp 73-76.

Address for correspondence

Dr. Elske Ammenwerth

University of Heidelberg

Institute for Medical Biometry and Informatics

Dept. of Medical Informatics

Im Neuenheimer Feld 400

D-69120 Heidelberg

Mail: Elske_Ammenwerth@med.uni-heidelberg.de

URL: http://www.med.uni-heidelberg.de/mi