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Acceptance of information technology in a clinical environment - results of quantitative and qualitative analysis -

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Abstract

Documentation of the nursing process is an important part of clinical documentation. We introduced a computer-based nursing documentation system on four wards of the University Hospitals of Heidelberg, and systematically evaluated acceptance issues in a 3-year prospective time series study. The quantitative results showed overall high acceptance of this system on most of the wards, with one exception. Qualitative analysis extended our results and showed what mostly unwanted effects computer support can have on documentation processes and communication patterns.

Keywords

Nursing process, Nursing Documentation Systems, Evaluation, User acceptance, Qualitative Interview Analysis, Communication

1. Introduction

Motivation is essential for learning, and important success factors for new computer-based systems are, therefore, users' motivation and users' acceptance of new ways of working (Dillon, T, McDowell, D et al. 1998). User acceptance is often even seen as the crucial factor in determining the success or failure of a project which introduces new information technology (Davis, F 1993).

Acceptance issues are also very important in the field of nursing documentation systems (Murphy, C, Maynard, M et al. 1994). Nursing documentation is an important part of patient-oriented clinical documentation. Paper-based documentation is often criticized as time-consuming, of low quality, and as an insufficient support of nursing care. Therefore, there have been some attempts and discussions on using computer-based documentation systems to support nursing documentation.

Some mainly quantitative studies analyzing how nurses accept computer-based nursing documentation have been conducted in the past (e.g. (Ammenwerth, E, Eichstädter, R et al.

2001), (Murphy C, Maynard M et al. 1994), (Newton, C 1995), (Bürkle, T, Kuch, R et al. 1999)). Those studies showed quite diverse effects with regard to user acceptance. For example, (Ammenwerth E, Eichstädter R et al. 2001) found high acceptance scores on one ward after 3 months and after one year of use of a computer-based documentation system, while (Newton C 1995) found very low acceptance after 3 months and after one year of use of computerized care planning.

It seems rather obvious that different factors such as functionality and usability of the documentation system, training and support, previous paper-based documentation processes, and other differences in the environment can influence a user's acceptance of a new computer-based system and thus its overall success. A detailed analysis of such factors is often missing in the various papers and is also difficult to obtain, due to the complexity of those often interrelated factors. A deeper knowledge of such factors, however, could be very helpful in order to plan the introduction of such a documentation system, and to avoid project failures. The quantitative evaluation methods usually used in acceptance research cannot explain the reasons for different staff reactions. Qualitative methods seem better suited here.

We therefore decided to systematically analyze both the acceptance of nurses with regard to computer-based nursing documentation on different wards, and the reasons for acceptance or non-acceptance. We chose four different (psychiatric and somatic) departments and conducted a prospective time series study with three points of measurement.

The goal of this paper is to present the study design as well as the results of quantitative and qualitative acceptance evaluation, with an intensive discussion of the unwanted broader effects of computer-based documentation systems on one ward.

2. Methods

2.1. Intervention

The software PIK, a nursing information and communication system, was chosen for the study and introduced on four wards of three different departments (Department of Psychiatry, Department of Pediatrics, and Department of Dermatology) of the University Hospitals of Heidelberg, Germany.

PIK is developed by a Germany-wide working-group, thus enabling us to participate in its development. In Germany, it is still one of the products with the most elaborate functionality for nursing documentation support, encompassing functionality for nursing anamnesis, nursing care planning, task documentation, and report writing.

2.2. Study design and study methods

We conducted a study with three measurement points

- 3 – 4 months before introduction ("before");
- 3 – 4 months after introduction ("during");
- approx. 9 months after introduction ("after").

For a quantitative evaluation of acceptance of computers in nursing, we used validated questionnaires: (Lowry, C 1994) for the acceptance of computers in nursing in general, and (Chin, J 1988) and (Ohmann, C, Boy, O et al. 1997) for the acceptance of the specific nursing documentation system PIK. All questionnaires were distributed to all nurses of the four wards before, during and after the introduction of PIK.

For a qualitative evaluation of acceptance, we conducted interviews and focus group discussions on each ward.

The study period was between August 1998 (pre-test on the first ward) and April 2002 (post-test on the last ward). Due to organizational reasons, the measurements could not be conducted at the same time on all of the wards.

The resulting quantitative acceptance scores were then aggregated and compared using statistical analysis procedures. The resulting qualitative results were analyzed using qualitative text analysis methods based on (Mayring 1993).

2.3. Study environment

In order to analyze our findings, it is important to present some background information about our study wards.

Nursing management selected three of the four wards for this study. After internal discussion, the majority of nurses on all of the wards agreed to participate. Ward B volunteered to participate by themselves. On all four wards, diverse computer-based clinical application systems such as systems for patient administration, drug and meal ordering, staff scheduling, ward management, printing of stickers and reports, intranet/internet and electronic mail have been in use for years.

Table 1 highlights some of the differences in our four study wards.

	<i>Unit</i>	<i>Patients' profile</i>	<i>Number of beds</i>	<i>Number of cases in 2000</i>	<i>Mean duration of stay</i>	<i>Number of nursing staff</i>
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 2 years	15	600	4,5 days	13
Ward D	Dermatology	Diverse dermatological cases	20	589	9,6 days	12

Table 1: Characteristics of the four pilot wards.

Our study wards varied significantly with regard to the typical procedures of nursing documentation. On wards A and B, nursing documentation could be called complete as it covered all phases of nursing care. In contrast, on wards C and D, only parts of nursing care have been documented, normally only with very reduced care planning.

Some of the nurses had prior computer experience (approx. half of the nurses stated that they were self-confident or rather self-confident with computers), but none had worked with computer-supported nursing documentation systems before the study. The self-rated computer confidence (scale 1 – 4, with 1 = lowest) were lowest on ward C (2.20 ± 1.03 , $n=11$) and highest on ward D (3.00 ± 1.00 , $n=11$) at the beginning of 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.

All wards were equally equipped with computers: two in the ward office, and one in an additional staff room. Equal training (2 – 3 hours in small groups) was provided for all nurses. On each ward, 1 - 3 motivated nurses were specially trained as key-users. In addition, all other health care professional team members (such as physicians, co-therapists, social workers) received an introduction to PIK and were provided with an account. To achieve data integration and to enable the exchange of administrative patient data, the software had an interface to the communication server of the Heidelberg hospital information system.

Computer-based nursing documentation systems allow for the storage of pre-defined problems, goals, tasks and care plans in order to support efficient nursing care planning. Before the introduction of PIK, the wards organized the coordinated development of these items. Before the introduction, about 36 psychiatric care plans, 23 pediatric care plans and 12 dermatological care plans were prepared.

2.4. Course of the study

The computer-based nursing documentation system was introduced as planned. We conducted the study according to the study plan. Overall, approx. 70 nurses, who worked with the nursing documentation system during the course of the study, received the questionnaires. The return ratio of the questionnaires was 82% for the 1st questionnaire, 86,5% for the 2nd questionnaire, and 90,2% for the 3rd questionnaire. Overall, 119 questionnaires were returned: Due to high staff fluctuation, only 23 nurses answered all three questionnaires, 17 nurses answered two questionnaires (including the staff of ward B which only received two questionnaires), and 16 nurses answered one questionnaire.

Cronbach's Alpha reliability coefficient for all three measurements was 0.74 – 0.84 for acceptance of computers in nursing, and 0.80 – 0.92 for the acceptance of PIK.

Two nurses from each ward were interviewed individually around the time of the third questionnaire. In addition, focus group interviews with 3 – 4 participants were performed in April 2002 for each ward. Additionally, focus group interviews were carried out with the 4 ward managers as well as with the 4 project managers of the nursing documentation system. The self reported daily usage of PIK was between 1 and 2 hours for each ward. The nurses who answered all of the questionnaires judged their self-confidence with PIK as rather high. On a scale from 1 (insecure) to 4 (secure), the self confidence was lowest on ward B (3.43 ± 0.51 , $n = 14$) and highest on ward D (3.78 ± 0.44 , $n=9$).

3. Results

3.1. Results of quantitative analysis

Based on the questionnaires for computer-based nursing documentation in general, and for the specific computer-based nursing documentation system, mean acceptance scores (1 = minimum, 4 = maximum acceptance) were calculated for each nurse and each ward.

Figure 1 and 2 show the differences between the four wards. Overall, they show high acceptance of computers in nursing (rising with the introduction of PIK), and a high acceptance of PIK itself (also rising). However, lower and partly even decreasing acceptance values could be found on ward C.

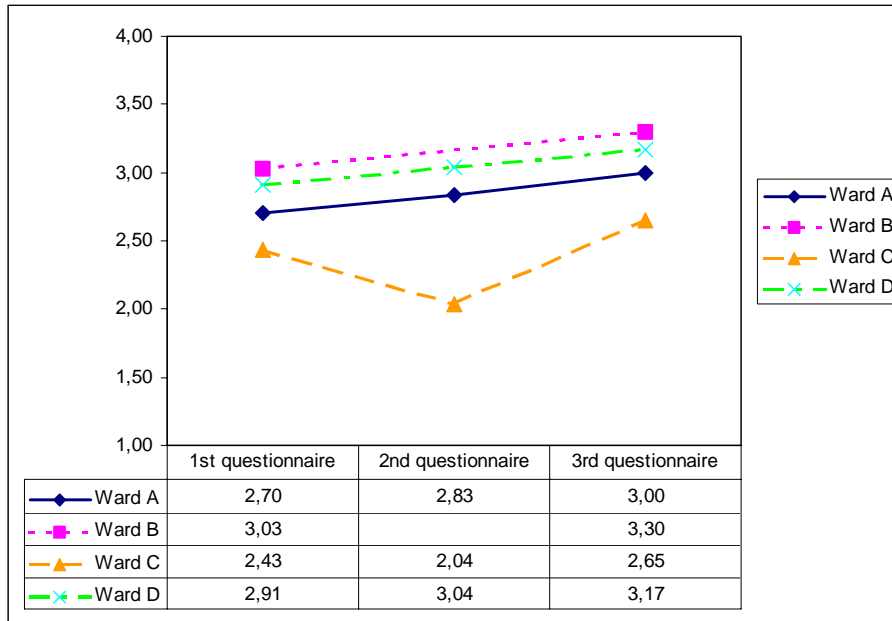


Figure 1: Mean acceptance scores of computers in nursing (1 = minimum, 4 = maximum) on the four study wards (n=31), for each of the three measurement points (1st = before introduction 2nd = during introduction, 3rd = after introduction of a computer-based nursing documentation system).

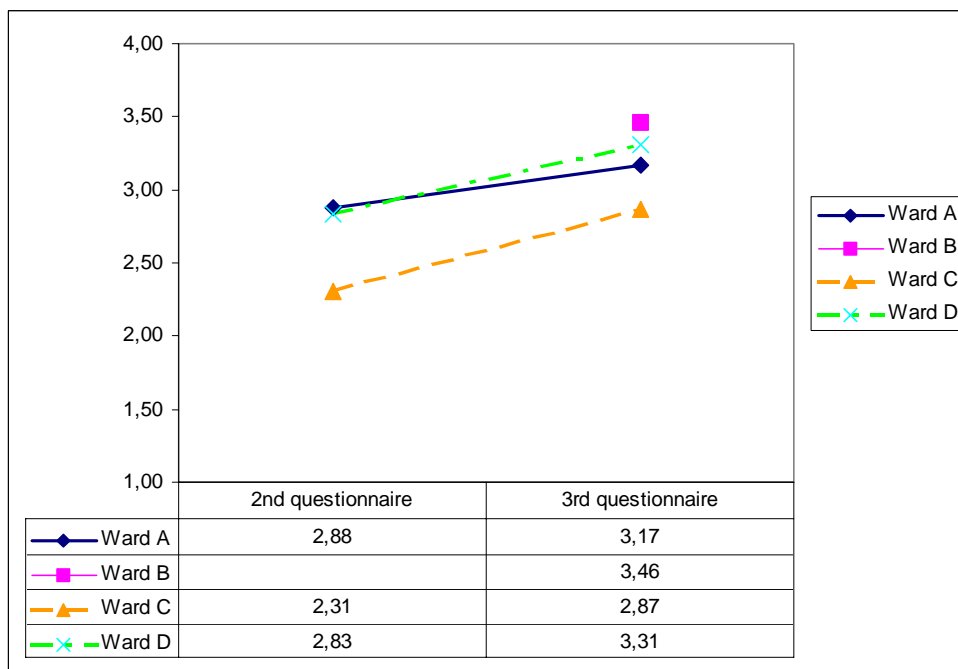


Figure 2: Mean overall acceptance scores of PIK, as stated by the nurses on the four study wards (n=39) which filled out both questionnaires (2nd = during introduction, 3rd = after introduction of a computer-based nursing documentation system), on a scale of 1 (= minimum) to 4 (= maximum).

The detailed questions on the effects of PIK also revealed some interesting differences between the study wards. On ward A and B, the nurses felt that PIK saves time, which was

not the case on ward C and D. On ward C, at the 2nd questionnaire, the nurses felt burdened in their work when using PIK. On wards A, B and D, the nurses stated that PIK makes documentation easier, which was not the case on ward C.

The quantitative analysis of the results thus showed that the wards reacted significantly differently to the documentation system. Especially on ward C, the acceptance scores initially heavily declined in the 2nd questionnaire, and were much lower than on the other wards in the 3rd questionnaire (see figure 1 and 2). On this ward, the nurses seemed to have experienced great disappointment when introducing the nursing documentation system, both with regard to the usefulness of computers in nursing in general and in this specific case. However, the introduction of the computer-based system, regarding training and support, seemed quite similar on all four wards. In addition, the reported daily usage of the system, and the self-confidence with its use, were also equal on all wards. What could the reasons be?

A further analysis of the quantitative results gave hints to two possible reasons.

First, we could see that computer experience was the lowest on ward C before the introduction of the computer-based system. Second, the process of nursing care had only partially been documented on wards C and D before. The introduction of a computer-based nursing documentation system increased documentation, since it forced increasingly complete documentation. Therefore, both wards complained about an increase in the amount of time needed for documentation. However, as this was also the case on ward D, this could not explain the measured differences in the acceptance score.

We now therefore turn to the results of the qualitative analysis of the focus group interviews which could much better reveal further reasons.

3.2. Results of qualitative analysis

Based on the focus groups interviews on each wards, we tried analyze the factors leading to the identified differences. For this paper, we will concentrate on the effects on ward C, where we found in the interviews that PIK heavily (and mostly negatively) affected working processes and communication patterns.

The nurses on ward C tried to integrate PIK in their daily work, but had to deal with a lot of problems from the very beginning. Some obvious reasons as stated by the nurses were:

- Computer knowledge problems: The nurses on ward C were of older age than the other wards, and less experienced with using the computers. They had major problems using the keyboard.
- Training problems: The nurses on ward C got an amount of training comparable to other wards, but from a different trainer who was motivated, but did not do an optimal job in training the nurses. ("We had a group training session, but I was, upon completing the session, just as wise as before.")
- Support problems: Ward C only had one motivated key-user, while the others had 2 – 3. The function of key-user was therefore partly taken over by the project manager who was, due to other obligations, not always available ("then you just had to wait").
- Technical problems: The interface between PIK and the patient administration system had some problems specifically during the time when ward C started. This lead to problems such as missing patients in PIK.
- Equipment problems: The computer systems on ward C were rather old and slow, compared to other wards ("Everything takes far too long").

Most of those problems could be solved after some time of use of PIK. However, the problem with regard to the slow computers remained, and could not be solved during the study period.

Another main problem discussed in the interviews was the amount of documentation in a pediatric ward, which is different from the other pilot wards. Documentation of nursing tasks has to be carried out 24 h/day, due to the young patients (mostly infants) and their great need for care. Thus, the overall amount of documentation is higher. In addition, patient fluctuation is also highest on ward C. A complete nursing anamnesis and nursing care plan must be established for each new patient. This is very time-consuming. Many tasks have to be conducted multiple times a day and thus also documented multiple times. Therefore, the nurses had to do an enormous amount of documentation (“When you’re sitting in front of the computer, and there are five children crying again outside, but you still need to complete documentation because you have eight or nine patients in the PC, then you usually sit there for about an hour if you do it correctly.”)

In addition, the number of available computer systems (3 – 4) was comparable to the other wards, but too low with regard to the amount of documentation. The nurses even reported a competition for the available computer systems (“Then you run to the next computer, and someone is also already sitting there”). This also led to time effort and frustration.

In the first weeks, the mentioned problems and the increased amount of documentation led to nursing overtime („I always finished at least an hour later...because of PIK“). The nurses partly overcame these problems by reducing the amount of tasks to be documented in electronic form, and by reorganizing their time schedule so that more time was available for documentation (“You need to sit down earlier“). The number of available computer systems was, however, further reported as much too low. Observations showed e.g., that nurses used the time of shift change to complete their documentation, which led to information losses and further frustration (“Sometimes I think that I had rather paid attention there“).

All those problems were important. However, two major reasons for the problems on this ward could be identified in the interviews:

- Reduced availability of the computer-based part of nursing documentation: Computer systems were only installed in the ward office. No bedside terminals or mobile computers were introduced. However, a large part of nursing documentation was previously done at the patients’ bedside.
- Distribution of nursing documentation on different media: Only a part of nursing documentation was supported by PIK. The other parts (e.g. vital signs, medication ordering) remained in paper-based forms.

Those aspects led to heavy changes in documentation processes and communication patterns on this ward:

The missing availability of the computer-based part of nursing documentation led to information losses during the work with the patients and their children in the patients room (“I don’t sit down at the computer [at the beginning of my shift], rather I go straight to my patients.“). Nurses started to organize double documentation in order to overcome this problem. Information was often documented on paper-based forms, to be later transferred into the electronic documentation in PIK („The basic measures such as medications, inhalations and vital signs are written in the paper record, but also later checked off as measures in PIK.“). They also used paper-based working lists in order to see which tasks to complete for each patient when they are in the patient room (“Otherwise I would forget it if I didn’t have my piece of paper where I have it written down.“).

PIK was also not available during the ward shifts. Before its introduction, the paper-based nursing record had been used for shift change. Now, all information has to be kept in mind. The nurses stated that this led to information losses (“I forget more during shift change since PIK is being used“).

The distribution of nursing documentation on diverse media lead to a kind of rivalry between paper-based and computer-based documentation. On this ward, the paper-based documentation clearly won, as it seemed to be better available (especially in patient rooms), and easier to use (“It worked in the room. You could take the child into your arms, and also write on the side. I can’t take the child into my arms and write [at the PC] though.”; “So you have to go to the computer again, then the parents are on your case, then it takes forever till you’re in the system, then you have to open the document, and search through all of the reports. It’s a large time effort..”). The nurses continued to use the paper-based documentation to support their individual work. Other health professionals such as the physicians also preferred the oral communication and the use of paper-based documentation. They did not used PIK.

In this context, another main problematic aspect occurred during the interviews which influenced the reaction to PIK was: PIK heavily compromised the usual communication patterns. Before, communication was based on the written documentation and on the oral information given mostly during shift changes. PIK influenced both paths of communication , as discussed before: It reduced the availability of written information, and it also lead to information losses in the shift changes. The ward tried to overcome this problem, e.g. through double documentation. However, discussion of the information losses also lead to the observation that there was no clear consent on the ward about the relationships between oral and written communication. Some nurses were of the opinion that written documentation is the main communication media, which is only enhanced by oral information. Other nurses thought that at least the important information has to be communicated orally (“I don’t know how many time I sat at night and read through the reports, where some have written, please don’t forget to do this and that. Sometimes there are things written down which don’t belong there..“). Overall, both forms of communication (written and oral) were obviously disturbed by PIK, and no clear rules existed with regard to how to overcome those problems.

Analyzing those problems, it is not surprising that PIK was found to disturb usual work routines and burden the nurses. Some problems were mastered by introducing double documentation, but this lead to other problems such as higher efforts for documentation. It is surprising that the ward continued to use PIK. We found the ward was overall motivated to participate in this pilot evaluation of a nursing documentation system, and they were still convinced that electronic documentation is essential to show what nurses ‘really do’.

However, they also stated that some fundamental changes had to be made in order to overcome the negative effects and to exploit the possibility of computer-based documentation. Mainly, the distribution of nursing documentation on different media must be overcome. The precondition is to improve the availability of computer-based information by introducing more and quicker computer systems (“Fast computers: 5 of them“), by introducing mobile computers or computers at the patients bedside, and by supporting further parts of documentation in the electronic system. However, the ward seems to need further support in their transition to a computer-based nursing record. Communication rules should be established which define how important information has to be communicated, and which role documentation plays in communication. This also leads to the question of which role documentation has overall in patient care: e.g. is it only a retrospective documentation of what has been done (mainly for legal reasons), or is it an active part for communication and workflow management? Those discussions don’t seem to be complete on this ward – as well as on other wards.

Overall, the nurses on ward C were quite disappointed with the effects of the computer-based nursing documentation system. They questioned its usefulness. On this ward, the nurses

complained heavily about an increase in the amount of time needed for documentation, a poorer overview of the course of patient care, and they felt burdened by the system. This example shows that the isolated computer-based support of parts of documentation is not feasible and can lead to various negative effects on working processes and communication patterns.

4. Discussion and Conclusion

We presented some results of an evaluation of user acceptance with a nursing documentation system using qualitative and quantitative methods. Quantitative results helped to obtain an overall picture of user acceptance. Our questionnaires showed interesting differences, especially on ward C. The qualitative evaluation helped us to understand reasons for these detected differences. They showed that documentation and communication patterns were heavily disturbed by computer-based documentation on ward C.

Recent literature stresses the need for an adequate combination of quantitative and qualitative evaluation methods in order to better grasp the 'real' picture (e.g. (Kaplan, B 1997), (Kelle, U 1993)). Our example showed how both evaluation traditions can be combined: Quantitative evaluation could give a very clear picture of the development on the different wards, and on the differences between them. However, only qualitative evaluation helped us to understand the reasons and to learn for future introduction projects. Summarizing, we found the combination of different evaluation methods in order to analyze user's acceptance both feasible and useful.

Our results can be used to assist the planning and introduction of computer-based nursing documentation systems. They demonstrate the importance of working processes and communication patterns as well as training, support and computer infrastructure.

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