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Evaluation of Acceptance of Nursing Information System in a German and American Hospital

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Abstract. Nursing Information Systems (NIS) are not well-adopted and accepted in Germany. The evaluation of a NIS deployment in a German University Hospital supports this assumption. A second side study in the US should point out the differences regarding the technical and organizational differences. We use a questionnaire including standardized instruments like the Unified Theory of Acceptance (UTAUT). Results indicated that nurses in Germany compared to in the US do not use nursing process documentation to the same extent. The main reasons behind the low usage in comparison with the US are deficits in ease-of-use, system performance and the high expenditure of time and paper work for charting nursing plans.

Keywords. Evaluation study, Acceptance model, Clinical information systems, Technology Acceptance

1. Introduction

The University Hospital Erlangen UKER started the implementation of a Nursing Information System (NIS) in March 2013 on five pilot wards. The purchased NIS is an integrated module of the commercial EHR system and provides assessment tools based on standardized classifications like NANDA diagnosis and a workflow engine to assist the documentation of care plans. The implementation was evaluated during the system deployment. The results showed a low acceptance of software functionalities and software ergonomics. The system usage decreased in one year. Nurses report a time-consuming and tedious use of the NIS and in performing nursing process documentation. The authors of previous studies have proposed that missing acceptance of NIS implementations is common in Germany. Previous surveys from 2002 [1], 2007 [2] and 2014 [3] which were distributed to more than 2,000 health care institutions (2007 return rate 270 = 12.4%) showed, that although the installations of NIS in Germany increased from 7% in 2002 to (58 institutions) in 2007, often only documentation of procedures and interventions was covered. Nursing diagnoses documentation, for example, was only established in 70% and mostly restricted to few wards of the responding institution. Research studies and case studies stress the fact that the nursing process is often not well-accepted by practitioners [4–7] and there are a number of technical and organizational problems regarding the implementation of NIS.

2. Study goals and objectives

These results at the UKER render a comparison with another major hospital site, where NIS and care plans are well-accepted, preferably outside Germany. We choose the

Intermountain Medical Center (IHC) in Salt Lake City with more than 15 years' experience in computerized nursing documentation and care planning as second side. Through empirical examination we hope to produce a more complete understanding of the necessary conditions of NIS adaption for the German context. The study hypotheses are presented in table 1.

Table 1. Hypotheses

Hypotheses
The NIS in the US is more useful to attain gains in job performance.
The NIS in the US is easier to use.
The technical and organizational infrastructure to support use is better in the US.
The nurses in the US perceived more social support to use the system.
The nurses' attitude toward the nursing process is more positive in the US.

3. Methods

3.1 Study context

The evaluation in Germany was conducted at the University Hospital located Erlangen, Bavaria, which provides more than 1,300 beds, with 42 different departments employing more than 7,400 employees. The five NIS-pilot wards are situated in the departments of otorhinolaryngology (23 beds), internal medicine (24 beds), neurology (28 beds), surgery (27 beds) and palliative medicine (8 beds). The IHC in Salt Lake City is the largest hospital in Utah with 454 beds. Intermountain Medical Center contains five interconnected centers, including women's/newborn care, heart/lung care, emergency/trauma care, outpatient care, and cancer care. The study at IHC was undertaken in the oncology (32 beds), surgery (32 beds) and medical units (32 beds).

3.2 Study design

A paper-based questionnaire was distributed to all nurses on the five pilot wards at the University Hospital in Erlangen and on four wards of the IMH Medical Center. Participation was voluntarily and anonymous. The questionnaire contains four parts:

Part A concerned basic demographic data such as age, position, working experience; computer skills and time spent at the computer.

Part B examined the use of the different NIS functionalities. Users were asked to rate their usage of different functionalities with "yes" and "no". The different functionalities of the local NIS were examined in a pre-analysis.

Part C contains the NACT scale to survey the attitude toward the nursing process documentation [8]. Users were asked to rate their level of agreement to the statements using a four-point Likert scale, where "1" corresponded to "disagree strongly" and "4" corresponded to "agree strongly".

Part D was based on the Unified Theory of User Acceptance (UTAUT) research model and comprised questions about the nurse's acceptance of the local NIS [9]. The UTAUT research model includes four core determinants: *performance expectancy* (PE), *effort expectancy* (EE), *social influence* (SI) and *facilitating conditions* (FC) to explain user's acceptance and usage. Users were asked to rate their level of agreement to the statements using a five-point Likert scale, where "1" corresponded to "disagree strongly" and "5" corresponded to "agree strongly".

Data analysis of the questionnaire comprises the calculation of the frequencies of the responses for questions using SPSS 20.0. All continuous variables will be summarized using the following descriptive statistics: n (non-missing sample size), mean, standard deviation, maximum and minimum. The reliability of the different scales is assessed using Cronbachs alpha (α). Differences between groups (IMH/UK ER) will be determined by Mann-Whitney-U-Test for continuous data and by chi-square (χ^2) test for categorical data.

4. Results

4.1 Socio-demographic data and reliability

A total of 225 questionnaires were collected; 122 in Germany and 103 in the US. This resulted in a net response rate of 28% in Germany and 15% in the US. No confounding effect of work experience (Mann-Whitney-U-Test; p = 0,116) was found, but regarding age (p = 0,05) and gender (χ^2test; p = 0,032). See Table 1.

Table 2. Sociodemographic data.

Setting	N	Age	Gender		Work experience
		In years	Female	Male	In years
UK ER	122	38,78	86	29	3.73
IMH	103	34,28	59	8	6.69

The reliability (expressed as Cronbach alpha) of the scales is displayed in table 2. Most alphas meet the minimal requirements of Nunnaly (>.70) [10]. The scale of the construct *Facilitating Conditions* does not meet the minimal requirements (α = 0.381). A closer inspection of the latter scale showed that one item did not correlate with all other items. After removal of this item, the reliability increased significantly (α = 0.677).

Table 3. Reliability of the Scales (*[1]Internal consistency reliability: Cronbach's Alpha; *recoded: they were negatively phrased*

Model	Construct	Abbr.	Items	ICR[1]
UTAUT	Performance Expectancy	PE	U6, RA1, RA5	0.861
UTAUT	Effort Expectancy	EE	EOU3, EOU5, EOU6	0.871
UTAUT	Facilitating conditions	FC	PBC2, PBC3, (PBC5*), FC3	0.677
UTAUT	Social Influence	SI	SN1, SN2, SF2	0.639
NACT [8]	Nursing process documentation	NA	1, 2*, 3*, 4, 5*, 9, 10, 11, 19	0.711

4.2 Acceptance of the Nursing Information System and the nursing process

Table 3 presents the average rating of the different constructs per group. Overall the results showed a moderate acceptance of the various measures.

Table 4. Descriptive statistics *([2]Standard derivation; [3]Mann-Whitney-U-Test for hypothesized significant differences)*

	UK ER			IMH			p-value[3]
	range	mean	s.d.[2]	range	mean	s.d.[2]	
PE	1-5	2.4350	0.99751	1-5	3.7451	0.78199	p = 0.000
EE	1-5	2.7479	0.85481	1-5	3.7516	0.71132	p = 0.000
FC	2-5	3.8174	0.56372	1-5	3.8176	0.62895	p = 0.933
SI	1.33-5	3.1871	0.90637	1-5	2.9462	0.96646	p = 0.303
NA	1.88-3.63	2.7996	0.41155	1.25-3.63	2.7699	0.49116	p = 0.959

Differences were found in rating of *performance expectancy* (PE) and *effort expectancy* (EE). In the German group the mean scale rating was significant lower, so they see less ease associating with the system and also do not believe that using the system will help to attain greater job performance. For example only 11.6% in the German group agree that "*Using the system enables accomplishing tasks more quickly*"; instead, in the US group, 65.4% agree. Other findings that stand out are the high ratings on the *social influence* and *facilitating condition* scale on both sides. The hypotheses about more social support and better organizational and technical infrastructure were rejected: German and American nurses seemed to have equally good support to use the system. The German nurses confirm a high support from senior management using the system (mean = 4.12). The mean scale rating of the nursing process (NACT scale) also indicates a similar attitude of both groups. When analyzing each statement we found the following points of interest. Nurses in Germany rate the time exposure ("*care plans are too time-consuming*") and the effort of care plans ("*care plans are too much paperwork*") significantly higher than in the US, even if they are also convinced that nursing plans have a high effect on the quality of care.

Table 5. Result summary

Hypotheses	Result
The NIS in the US is more useful to attain gains in job performance.	Supported.
The NIS in the US is easier to use.	Supported.
The technical and organizational infrastructure to support use is better in the US.	Not supported.
The nurses in the US perceived more social support to use the system.	Not supported.
The nurses´attitude toward the nursing process is more positive in the US.	Not supported.

4.3 Use of NIS functionalities

Figure 1 illustrates the usage of different NIS functionalities. The NIS in both countries offers the possibility to chart nursing diagnosis, goals, interventions and a nursing assessment. We also ask for the use of the NIS for the shift handover. The results show a significant differences in the usage of the nursing diagnosis (χ^2test, p = 0.001) and nursing goals (χ^2test, p = 0.000). In Germany more than 60% of the nurses do not use the diagnosis and goals. Nearly all nurses chart the assessment and the interventions, so there are no differences between German and US usage. The data also suggest the great difference in the use of the NIS to support communication. According to the statistics only 5% of the German nurses have the NIS in use at the handover.

Table 6. Self-reported use of functionalities

Usage of NIS functionalities	UK ER	IMH
Nursing diagnosis.	38,65 %	71,7%
Nursing goals	45,6%	80,4%
Nursing interventions	86,0%	81,8%
Nursing assessment	96,0%	81,8%
Using the NIS for handover situations	5,3%	66,7%

5. Discussion

The objectives of this study were to analyze the necessary conditions for a well-adapted system. We could illustrate that the nurses in the US have a higher acceptance of the NIS, leading to higher ratings on the performance expectancy and effort expectancy.

The reason behind the greater performance can be seen in the NIS design. The NIS in the US does not have strict workflows, free text input is allowed and the catalogue for nursing diagnosis is well selected. The German NIS is an integrated module of the commercial EHR system and offers internationally standardized classifications like NANDA and a workflow engine to assist the planning and the documentation of care, which restricts the freedom of individual care plans. With further regression analysis we will get a better insight which UTAUT constructs are the best predictors of the acceptance and use of NIS. UTAUT is considered state-of-the-art in technology evaluation [11], but some previous studies in the medical field using UTAUT suggest that the model can only explain around 30% of the variance in behavioral intension [12–14] this is lot less than the 70% Venkatesh at al. found when they developed the model. We also see the need for a deeper analysis of the different constructs by using qualitative data. The organizational structure in both countries is quite different. For example the specialization into RNs and CNAs does not exist in Germany. The comparison of the work organization using observations or interviews could be the right way to gain a better understanding of the factors influencing the adoption.

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