Stormont Vail Health

Psychometric Evaluation of a Nurse Alert Perception Survey

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Introduction

Nurses represent a significant proportion of clinician end users, yet little is known about the incidence or impact of alert fatigue in nursing. Alert fatigue has been described as a form of cognitive overload that desensitizes clinicians to future alerts[1-3]. An untitled survey instrument developed by Zheng et al.[4] to assess prescribers' perceptions of computerized drug-drug interaction (DDI) alerts was adapted with permission in an investigation assessing nurse perceptions of electronic best practice advisory (BPA) alerts. BPAs are a clinical decision support software tool incorporated in electronic health record products developed by Epic Systems Corporation (Verona, WI). The BPA alerts of interest were the interruptive pop-up messages in nursing workflows that require nurse action to exit the BPA message. The purpose of this study was to evaluate the psychometric properties of the adapted survey instrument and discuss its possible usefulness to inform future studies.

Instrument

The 25-item survey instrument is grounded in the unified theory of acceptance and use of technology (UTAUT) and an adapted accident causation model. UTAUT identifies four significant determinants of behavioral intention (technology acceptance) and use behavior (UB): perceptions of expected benefits in productivity or job performance (PE), ease of use (EE), the direct or indirect degree of significant others' influence on the individual user (SI), and organizational or technological infrastructure supporting or impeding use (FC). Four factors moderate the relationships between constructs: age, gender, experience, and voluntariness[5]. The adapted accident causation model by van der Sijis, Aarts, Vulto, and Berg provided a context to interpret nurses' responses and perceptions of alert fatigue[4].

The adapted survey assessed five UTAUT concepts and one from the adapted accident causation model (Table 1). Three items specific to prescribing clinicians and DDI alerts were deleted and all references to DDI alerts were replaced with BPA alerts. The item "*DDI alerts presented to me during order entry change my prescribing decisions*" was modified to read, "*BPAs presented to me during documentation activities change my clinical decisions*". The four introductory questions assessing the level of alert interaction were modified to a usual work shift time frame. The survey scoring strategy based on self-reported levels of BPA interactions and Likert scales was retained. Items relating to UTUAT modifying factors (age, gender, computer competency skill level) and variables of interest (type of nursing licensure, primary workplace setting, work shift length) were added.

Table 1. Adapted Survey Instrument

Descriptor[a]	Construct[b]	Item
PRE1		During an average shift, how many Best Practice Alerts (BPAs) do you receive in Epic? _____ (please provide an estimated number)
PRE2		Of the BPAs you receive, what percent do you read thoroughly? _____
PRE3		Of the BPAs that you read, what percent do you find relevant? _____
PRE4		Of the BPAs you find relevant, what percent change your practice decisions?____
Scale for Q1 – Q18: Strongly Disagree, Disagree, Agree, Strongly agree, Does not apply		
Q1	PE	Best Practice Advisory alerts (BPAs) are useful in helping me care for my patients.
Q2	PE	BPAs are relevant to the individual patients for which they occur.
Q3	PE	BPAs I receive are clinically important.
Q4	PE	BPAs help me provide safe, effective patient care.
Q5	PE	BPAs help me reduce professional risk by preventing potential adverse events in my patients.
Q6	PEU	I find BPAs easy to understand.
Q7	PEU	The system makes it easy to respond to BPAs.
Q8	EE	Reading and responding to BPAs takes too much time.
Q9	EE	I repeatedly receive BPAs to which I have already responded.
Q10	EE	Reading and responding to BPAs interferes with my workflow.
Q11	SI	I read and respond to BPAs because my colleagues read and respond to them.
Q12	SI	My supervisor (e.g., attending physician, nurse managers) encourages me to read and respond to BPAs.
Q13	SI	Reading and responding to BPAs helps to improve my professional image.
Q14	FC	I received adequate training on how to read and respond to BPAs.
Q15	FC	I have adequate clinical knowledge to understand BPAs.
Q16	FC	The system provides adequate explanations of clinical relevance for BPAs.
Q17	FC	If I have questions about BPAs, I always have someone to consult with.
Q18	PF	During documentation activities, I have too many BPAs that I must read and respond to.
Scale for Q 19-21: Never, Rarely, Less than half of the time, More than half of the time, Always, Does not apply		
Q19	UB	I thoroughly read the Best Practice Advisory (BPAs) that I receive.
Q20	UB	I provide reasons/comments for the BPAs that I decide to override.
Q21	UB	BPAs presented to me during documentation activities change my clinical decisions.

[a] Introductory questions designated as "PRE". Questions relating to theoretical construct items designated as "Q".
[b] Construct assignments from original source survey: PE = performance expectancy, PEU = Perceived effort expectancy, EE= Effort expectancy, SI = Social influence, FC = Facilitating condition, PF = Perceived fatigue, UB = Perceived use behavior (Zheng et al., 2011).

Procedure

The study was conducted at a 586-bed Midwestern hospital. Following IRB approval, data were collected for one month from hospital-based nurses using SurveyMonkey®. An invitation containing an overview of the study, human subject considerations, and a hyperlink for survey access was distributed via hospital email accounts. Participation was voluntary and survey completion indicated informed consent. A total of 1088 nurses were invited to participate and 146 surveys were submitted. Data were entered in SPSS 22. Likert scale responses were converted to standardized z-scores for analysis. The "*Does not apply*" response option and unanswered survey items were treated as missing data.

Results

Nurse age ranged from 22 to 69 years (mean 38.6); 92.4% were female and 6.9% male. The sample was comprised of 8 LPNs (5.6%) and 136 RNs (94.4%). Usual shift length was reported as 12 hours (61.1%), 8 hours (34.7%), or neither 8 or 12 hours (3.5%). Computer competency skill level was reported as limited (1.4%), average (16%), proficient (59%), or advanced (16%). Primary practice areas were identified as Medical-Surgical (38.2%), Critical Care (13.9%), Perioperative services (9%), Emergency (6.25%), Non-Direct (13.9%), and Other (18.75%).

The distributions of item responses were generally normal with a skewness range of -.321 (Q11) to -1.888 (Q15), indicating more positive agreement/greater level of perceived use behavior. The KMO index value of .874, Bartlett's test of sphericity (X2 = 1703.096, df 210, p = .0001), and communality findings supported a decision to proceed with factor analysis. Subject responses to the 21 theoretical construct items were subjected to factor analysis using principle component extraction with Varimax rotation. Complete factor data using listwise deletion was available for 115 subjects (subject to item ratio of 5.5 to 1). The scree plot and eigenvalues > 1 resulted in a four-factor solution explaining 69.008% of variance. All items loaded with a primary value of ≥ .570 on at least one component and 17 items loaded on a single component. The factor solution and internal consistency results for subscales derived from factor analysis are presented in Table 2.

Table 2. Rotated Component Matrix for Reduced Solution at Decision (n=115)

	Factor				
Descriptor	1	2	3	4	h^{2b}
Q1	**.839**				.799
Q2	**.748**				.703
Q3	**.870**				.813
Q4	**.881**				.867
Q5	**.886**				.846
Q6	.432	**.655**			.668
Q7		**.632**			.580
Q8			**.788**		.630
Q9			**.749**		.646
Q10			**.796**		.648
Q11				**.700**	.674
Q12	.408			**.662**	.726
Q13				**.716**	.705
Q14		**.665**			.506
Q15		**.770**			.705
Q16		**.753**			.671
Q17		**.748**			.642
Q18			**.853**		.747
Q19	**.630**				.549
Q20	**.570**			.533	.631
Q21	**.738**			.409	.727
Initial eigenvalues[c]	8.543	2.594	2.215	1.140	
Percentage of variance explained	40.682	12.353	10.546	5.427	
Cronbach's alpha[d]	.939	.856	.848	.824	

Bold type indicates primary factor loading for each item.
[a]Factor 1 = Benefits (PE/UB); Factor 2 = Facilitators (FC/PEU); Factor 3 = Barriers (EE/PF); Factor 4 = Social influence (SI). Factor loadings <.40 not shown.
[b]h^2 = extraction (final) communalities (row sum of squared loadings).
[c]Eigenvalues = pre-rotation column sum of squared loadings.
[d]Cronbach's alpha reported for primary loading items.

Nurses (n = 136) reported receiving an average of 6.2 BPA alerts (SD 7.78, range 0-50) during a work shift. Of the BPA alerts received, an average of 53.1% (SD 38.74, n = 128) were read. Of the BPA alerts that were read, an average of 38.1 % (SD 33.48, n = 128) were considered relevant. Of the BPAs that were relevant, an average of 28.3 % (SD 20, n = 126) changed practice decisions. The number of alerts received (PRE1) was weakly correlated with the perception of having too many BPAs to read and respond to (Q18) (r = .360, p > .001, n = 117). No significant relationships were found between the clinical unit and the number of BPAS received during a work shift.

Age was the only UTAUT moderating factor found to have significant relationships with survey items. As age increased, the lower the percentage of BPAs that were read (r = -.232, p = .009, n = 126). Of the BPAs that were read, a lower percentage were deemed relevant (r = -.293, p = .001, n = 126). Of the BPAs that were found to be relevant, a lower percentage changed practice decisions (r = -.295, p = .001, n = 124). The older the subject was, the lower they self-rated their computer competency skill level (r_s = -.253, p = .003, n = 138). A weak negative correlation was found between age and three subscale scores, indicating a less positive agreement/lower level of perceived use behavior (Table 3).

Table 3. Bivariate correlations among age and subscales of survey (N=116-121)

Subscales	Age	Benefits	Facilitators	Barriers
Benefits	-.198*			
Facilitators	-.181*	.477***		
Barriers	-.199*	.266**	.235**	
Social influence	-.210	.672***	.494***	.421***

*p<.05, **p<.01, ***p<.001 (Bonferroni approach for 10 correlations: .05/10 = .001)

Discussion

This is the first known psychometric testing of an adapted form of this survey instrument in a nursing population. The survey demonstrated acceptable psychometric properties; however, the subscale item compositions described by Zheng et al.[4] were not replicated in this study. In particular, the combination of PE/UB items in the Benefits subscale (Factor 1) was an unexpected finding. A literature search to identify other studies utilizing this untitled instrument was unsuccessful. In addition, the lack of a comparable validated instrument precluded the ability to perform concurrent validity assessments.

Although the modest number of BPAs received per work shift (6.2) and nurse responses in this study do not provide clear evidence of cognitive overload and/or alert fatigue, BPAs represent only one type of the EHR and medical device alerts that nurses are chronically exposed to. As the concept of alert fatigue is complex and not directly measurable[1], perceptions alone may not be sufficient to elucidate the phenomenon. The survey demonstrated potential benefit for use in future investigations of nurse alert perceptions. Future investigations with larger sample sizes that incorporate actual EHR system alert data and direct observation to triangulate nurse perceptions would contribute to a greater understanding of nursing alert fatigue.

References

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