

Une évaluation formative de l’usage des appareils électroniques par les infirmières dans un contexte de soins à domicile

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Notre étude avait pour but d’évaluer l’implantation d’un système d’information clinique (SIC) dans un cadre communautaire. Les chercheurs ont établi une méthodologie mixte composée d’entrevues, de groupes de discussion et d’enquêtes. On a interrogé un échantillon transversal indépendant composé d’infirmières. En tout, 118 infirmières ont répondu à l’instant 1 et 81 infirmières à l’instant 2 ultérieur. Les répondantes étaient modérément satisfaites des caractéristiques du SIC. Dans le premier groupe, on relève un lien positif entre la satisfaction des usagers, l’accès aux ressources structurelles et électroniques et le capital social, et un lien négatif avec l’âge des infirmières; dans le deuxième, un lien positif entre le capital social et la satisfaction des usagers. Dans les deux groupes, on relève un lien entre la jeunesse et l’utilisation de la recherche. On constate un lien négatif entre l’application de la recherche et l’évaluation et le retour, mais un lien positif avec les interactions formelles. Notre évaluation fait ressortir l’importance du soutien éducatif, d’une conception axée sur l’usager et du degré d’intérêt pour la mise en œuvre réussie d’un SIC dans un cadre communautaire.

Mots clés : système d’information clinique, appareils électroniques, soins à domicile, utilisation de la recherche

A Formative Evaluation of Nurses' Use of Electronic Devices in a Home Care Setting

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The purpose of this study was to evaluate the implementation of a clinical information system (CIS) in a community setting. The researchers used a mixed-method design involving interviews, focus groups, and surveys. An independent cross-sectional sample of nurses was surveyed. At time 1 a total of 118 nurses responded and at time 2 a total of 81. Respondents were moderately satisfied with features of the CIS. User satisfaction was positively associated with access to structural and electronic resources and social capital and negatively associated with nurses' age at time 1. Social capital was positively associated with user satisfaction at time 2. Younger age was associated with overall research use at both time 1 and time 2. Research use was negatively associated with evaluation and feedback but positively associated with formal interactions. This evaluation identified the importance of educational support, user-centred design, and responsiveness to successful implementation of CISs in a community setting.

Keywords: community health nursing, informatics, research utilization/ evidenced-based practice, technology

Introduction

With the transition of nursing practice from the traditional framework of experiential and intuitive knowledge to an evidence-informed framework, the quantity and quality of evidence-based resources, such as practice guidelines, have markedly increased (Protti, 2008). The literature highlights the benefits to nursing and patient outcomes of the best available research evidence to support clinical decisions (Estabrooks, 2003; Estabrooks, Floyd, Scott-Findlay, O'Leary, & Gushta, 2003; MacIntosh-Murray & Choo, 2005). Decision aids, such as screening and assessment tools, can support evidence-based practice (Randell, Mitchell, Thompson, McCaughan, & Dowding, 2009), but for many nurses the utilization of evidence-based resources in decision-making remains a challenge.

An essential feature of information management is ensuring that the information is accessible at the time of decision-making. In nursing, this imperative has been constrained by limited access to evidence-based guidelines at the point of care. Information technologies such as personal

digital assistants (PDAs) and handheld computers (tablets) offer solutions for getting evidence to nurses directly at the point of care. Recognition of PDAs as a valuable information tool in nursing practice is relatively recent (Garrett & Klein, 2008; Honeybourne, Sutton, & Ward, 2006; Stroud, Smith, & Erkel, 2009). Research suggests that handheld technology can promote timely communication, enable evidence-based practice, and streamline patient care by capturing clinical data (Doran et al., 2010; Hardwick, Pulido, & Adelson, 2007).

Much of the research related to electronic information systems reports completion rates or workload percentages, with limited feedback from frontline users (Poissant, Perfeira, Tamblyn, & Kawasumi, 2005). There are gaps in the literature related to when and how nurses use evidence-based information to inform their clinical decisions and how decision-support systems can be designed to support nurses' clinical workflow. Moreover, the unique decentralized environment of home care nursing requires an enhanced implementation and integration strategy.

This article reports on the formative evaluation of a clinical documentation system for community nursing, focusing on integration of standardized assessment tools into clinical documentation and incorporation of evidence-based practice resources. For the evaluation, community nurses were provided access to clinical documentation, evidence-based resources through BlackBerry devices, e-mail, and a secure portal. Nurses documented patient outcomes using standardized outcome measures developed by the Health Outcomes for Better Information and Care (HOBIC) program. They had access to two Internet resources: the Registered Nurses Association of Ontario (RNAO) Best Practice Guidelines (Registered Nurses Association of Ontario [RNAO], 2011) and the McMaster University Nursing Plus library (Health Information Research Unit, 2008).

HOBIC is funded by the Ontario government (Pringle & White, 2002). The outcomes data (e.g., symptoms, therapeutic self-care) are collected electronically when nurses complete patient assessments and are used by nurses to monitor the impact of care and to ensure, for example, that patients are prepared for discharge. The RNAO launched the nursing Best Practice Guidelines program in 1999, with funding from the Ontario Ministry of Health and Long-Term Care (RNAO, 2011). The guidelines have been adapted for PDAs and smartphones. There is evidence that their use results in improved outcomes (Prentice et al., 2009). Nursing Plus Best Evidence for Nursing Care from McMaster University's Health Information Research Unit allows nurses to register their areas of clinical interest in order to receive e-mail alerts about publication abstracts relevant to those areas. Nurses have access to a searchable database of the best evidence from the medical literature, an e-mail

alerting system, and links to selected evidence-based resources (<http://www.caretoknow.org/link/nursing-plus-best-evidence-nursing-care>).

Purpose of the Study

The purpose of the study was to evaluate the implementation of an automated clinical information system (CIS) in a community setting. The CIS enables nurses to document admission assessments, discharge assessments, and client re-assessments when there is a clinical change. Nurses also document administrative data such as visit information for scheduling, billing, and payroll purposes. In addition, the CIS provides nurses with access to the evidence-based resources described above. The study investigated nurses' perceptions of barriers to and facilitators of adoption of the CIS and evaluated changes in organizational context and evidence-based practice over time.

Literature Review

A review of the literature on the use of electronic health information systems in home care found that the top three facilitators for the use of information systems were portable technology, strategies for decreasing data-entry errors, and managerial support during implementation (Stolee, Steeves, Glenny, & Filsinger, 2010). Another literature review concluded that computer experience, system design, and system performance, such as speed, were the primary factors influencing nurses' attitudes towards health-care information technology (Huryk, 2010). A survey of registered nurses in the state of Ohio found that computer experience, user involvement, and nursing-management support significantly explained information system use (Abdrbo, Hudak, Anthony, & Douglas, 2011).

A study with home care health workers in Sweden found that the non-intervention group improved in terms of documentation, whereas the intervention group showed a trend towards deterioration in documentation; no benefits were observed with regard to staff satisfaction (Engstrom et al., 2009). In contrast, a Dutch study with nursing assistants and registered nurses in acute-care settings found that nursing staff associated electronic patient records with improved care (deVeer & Franke, 2010). A qualitative study examined the impact of PDAs on patient care (Honeybourne et al., 2006). The authors report that 11 of the 12 staff members reported a benefit of handheld systems in addressing immediate patient concerns. A key point in providing evidence at the point of care was the speed at which the information was delivered.

Qualitative research by Garrett and Klein (2008) explored the perceptions of advanced practice nurses (APNs) on the value of wireless PDA technologies. APNs identified improved patient care as the major benefit

of PDA use. Clinical reference applications such as drug and diagnostic/laboratory reference applications and wireless communication were the tools that appeared to be most useful to the participants. Doran et al. (2010) report significant improvements regarding barriers to research utilization, quality of care, and job satisfaction for nurses who were provided access to information resources via PDAs. Our study was designed to advance this research by investigating changes in self-reported research utilization following the implementation of a CIS on BlackBerry devices.

Theoretical Perspective

The Stagers and Parks Nurse-Computer Interaction Framework served as a framework for studying facilitators of and barriers to nurse acceptance of the automated CIS (Stagers, Thompson, & Snyder-Halpern, 2001). The Stagers and Parks framework conceptualizes the nurse-computer interaction as a system of mutual influences that together promote adaptation to computerized documentation tasks. Successful adaptation is dependent on nurse characteristics, computer characteristics, and the context in which the nurse will be using the CIS. Nurse characteristics include flexibility in adapting to change, cognitive abilities, learning styles, attitudes towards computers, and computer experience (Whittaker, Aufdenkamp, & Tinley, 2009). Computer characteristics include types of hardware, screen displays, and software programs (Whittaker et al., 2009). User context is the environment in which the CIS is implemented and utilized.

The Promoting Action on Research Implementation in Health Services (PARiHS) model (Kitson, Harvey, & McCormack, 1998; Rycroft-Malone et al., 2004) provided the framework for studying the impact of context on nurses' use of the CIS and impact on evidence-based practice. The successful implementation of evidence is conceptualized as a function of the relationship between (a) the nature of the evidence; (b) the context in which practice change will occur (prevailing culture, leadership roles assigned, and measurement and feedback); and (c) the mechanisms by which the change is facilitated (Kitson et al., 1998; Rycroft-Malone et al., 2004). The PARiHS model was used to explain variation in nurses' research utilization in two recent Canadian studies. In the first, the largest proportion of variation in research utilization was explained by nurse-level variables; however, both specialty and hospital-level variables (i.e., context) contributed a small but significant proportion of the variance in research utilization (Estabrooks, Midodzi, Cummings, & Wallin, 2007). In another multilevel analysis of variables derived from the PARiHS model by the same group of researchers, hos-

pital characteristics that positively influenced nurses' research utilization were staff development, opportunity for nurse-to-nurse collaboration, and staffing and support services (Cummings, Estabrooks, Midodzi, Wallin, & Hayduk, 2007). Nurses working in contexts with more positive culture, leadership, and evaluation reported significantly more research utilization.

The present study had four objectives:

- Determine the usability of the CIS during the formative phase of implementation.
- Determine the extent to which nurses' clinical and organizational processes have been impacted by the implementation of the automated CIS.
- Assess how the organizational context — specifically, presence of electronic documentation, leadership, culture, opportunity for evaluation feedback, informal interactions, formal interactions, structural and electronic resources, and organizational resources or *slack* — changes over time as a result of the CIS implementation.
- Assess the effect of the CIS on evidence-based practice.

Methods

A CIS was designed collaboratively with nursing and health informatics experts and professional practice leaders within the agency. The CIS development included three distinct components: a comprehensive clinical assessment tool, an innovative portal system, and automated reporting. The CIS was designed to follow the nurse's workflow at the point of care through ease of navigation between system elements. HOBIC documentation was integrated into the system and allowed the nurse to review the impact of interventions on client outcomes. The application included auto-population functions where appropriate, decision support in the form of pop-up reminders, forced constraints, pick lists, and multi-select options, along with space for free text to document client narrative if desired. The portal includes *store-and-forward* technology to minimize barriers to using the device when the nurse is outside of network areas. The portal was designed as view-only, with the ability to enable internal and external access to the health-care team. An automated reporting feature for client outcome measures and key administrative reports was created. Updates and continuous improvements to the application were scheduled in response to feedback from nurses and clinical supervisors.

Design

A mixed-method design was used to collect data on the study variables. Qualitative descriptive methodology (Sandelowski, 2000, 2010), involving

semi-structured interviews and focus groups, was used to build a contextual understanding of barriers to and facilitators of automated CIS adoption and to determine how assessment tools and best practice evidence influence clinical decisions, why, and with what result. Surveys were used to collect quantitative data on nurses' satisfaction with features of the automated CIS, change in evidence-based practice, and change in organizational context over time.

A cross-sectional sample of nurses was surveyed and interviewed at two points: approximately 6 months after implementation (time 1) and approximately 18 later (time 2). The cross-sectional nature of the two samples meant that it was impossible to link time 1 and time 2 scores.

Approval for the study was obtained from the institutional research ethics review board of the university and the Community Care Access Centres. All participants gave written informed consent before the interview. Completion of surveys was anonymous.

Setting and Sample

The research was conducted at a home care provider agency in Canada. Home care nurses were given a BlackBerry device for use during clinical visits. A total of 118 nurses responded to the time 1 survey. Of these respondents, 71% (80) were registered nurses, 64.3% (72) worked in the staff/visiting nurse role, and the majority worked within the adult comprehensive home care program (57.1%). The majority of respondents were female (91.1%), diploma/certificate-prepared (65.2%), and worked part-time or casual hours (54.5%). The majority of respondents had used the application for 6 months or less (81.3%) and were using the system for only 4 to 10 hours per week (60.7%). Thus the time 1 respondents were novice users.

A total of 81 nurses responded to the time 2 survey. Of these, 69% (54) were registered nurses, 55.1% worked in the staff/visiting nurse role, and, similarly, the majority worked within the adult comprehensive home care program (77.8%). Approximately 95% were female, 67.1% were diploma/certificate-prepared, and 50.0% worked full-time. Of the respondents, 53% had used the application for more than 1 year at time 2.

Data Collection

Semi-structured interviews. Eleven semi-structured interviews were conducted with a stratified sample of staff nurses and supervisors from the home care agency, with the goal of delineating (1) barriers to and facilitators of CIS adaptation; (2) issues related to software and technology; (3) assessment-tool influences on clinical decisions; (4) where, within the

clinical workflow, information resources and best practice guidelines are needed or are most helpful; and (5) any constraints (e.g., time, technology) that inhibit nurses' ability to use the automated CIS. The interviews were conducted by telephone by a member of the research team trained in qualitative methods.

Focus groups. Five focus groups with supervisors and staff nurses were conducted at the start of time 2 to confirm qualitative themes from time 1 interviews and further define specific areas of interest or concern to CIS users. The focus groups were conducted by a member of the research team and were recorded for the purpose of data analysis. They were scheduled to coincide with regular supervisory and/or staff meetings.

Usability evaluation. An adaptation of the Questionnaire for User Interface Satisfaction (Norman, Slaughter, Schneiderman, & Harper, 1988) was used to collect data on nurses' satisfaction with features of the automated CIS and BlackBerry. Validity was established for the original questionnaire. Nurses were asked to rate their satisfaction with each of the resources on a nine-point scale, with positive adjectives (e.g., *satisfying*) anchoring the right end and negative adjectives (e.g., *frustrating*) anchoring the left. One item examined nurses' overall reaction to the system. Four items asked about characteristics of the device; six items asked about terminology; nine items asked about system capabilities, such as speed and network access; four items asked about ease of learning to use the system; and six items asked about teleconferencing support for new users.

Organizational context. The Alberta Context Tool (ACT), a 58-item instrument developed by Estabrooks and colleagues (Estabrooks, Squires, Cummings, Birdsell, & Norton, 2009), was used to measure features of the organizational context. The 58 items include variables of leadership (6 items); culture (6 items); feedback processes/evaluation (6 items); organizational resources (11 items); organizational slack, including time (4 items), space (3 items), and staffing (3 items); informal interactions (9 items); formal interactions (4 items); and social capital (6 items). Cronbach's alpha has been reported as ranging from 0.37 to 0.92 for a 10-concept version (Estabrooks, Squires, Hayduk, Cummings, & Norton, 2011). Construct validity was established with confirmatory factor analysis (Estabrooks et al., 2011). Cronbach's alpha for the 10-concept version used in this study ranged from 0.50 to 0.91.

Nurse variables. Data on nurse demographic characteristics, including education, experience, and professional designation, were collected through questionnaires. Data were collected on nurses' attitude towards research (items adapted by Estabrooks from Lacey [1994] with permission), and *belief suspension* (both components): willingness to use research (0.80) and implementation of research in practice, using items developed

by Estabrooks (1997). Cronbach's alpha ranged from 0.74 for "belief willing to implement research" at time 2 to 0.85 for "belief actually implement research" at time 2.

Data Analysis

Two-sided *t* test was used to compare the mean difference of subscale scores and study variables between time 1 and time 2. Two-tailed *p* values were computed based on *t* distribution under the null hypothesis (i.e., equal means). Regression analysis was employed to detect the associations between organizational context and research utilization and overall user reactions to the CIS. All statistical tests were performed at the 0.05 significance level. All quantitative data analyses were performed using Statistical Analysis Software (SAS) 9.3. A multilayered content analysis of qualitative data from interviews and focus groups was conducted using NVivo 8 qualitative-analysis software. Responses to open-ended interview and focus group prompts were coded into main ideas and themes related to the specific objectives of the study. Content themes were confirmed and validated through literature consultation, participant feedback, and professional teams.

Findings

Qualitative Findings

Content analysis of the interviews was conducted using the Staggers and Parks Nurse-Computer Interaction Framework (Staggers & Parks, 1993). The primary themes of this analysis highlight the particular relevance of *nurse characteristics*, especially time-management skills and job satisfaction, and *contextual characteristics* related to documenting at the point of care and orientation towards client care. Secondary themes concerning *characteristics of the device and assessment tools* are also discussed.

Nurse characteristics. Skills in time management and planning for the clinical setting emerged as a primary theme with regard to willingness to adapt to CIS use. Nurses who anticipated the importance of clinical time-management for introducing the device to clients and for troubleshooting expressed more positive feelings about the device. Job satisfaction and positive attitude towards both the employer and the vocation of community nursing emerged as an important theme for willingness to adapt clinical practice to device implementation. Nurses who enjoyed educating clients and families, felt supported in their careers by co-workers and management, or connected with the vision of the agency also spent more time learning to use the device and seeking help in implementing it in the community.

Context characteristics. Integrating the use of the handheld device in a clinical setting was the primary theme. An orientation towards client care and a belief that patient care is positively affected by use of the device influenced nurses' willingness to adapt their practice and implement the BlackBerry. Furthermore, nurses who felt better able to measure and track client outcomes expressed more willingness to participate in training activities or seek feedback from colleagues in order to increase their ability to use the device at the point of care. Nurses who expressed difficulties connecting clinical outcome improvements to documentation at the point of care or through the use of standardized assessments were less willing to fully implement the CIS. These difficulties included lack of knowledge or language in how to introduce the device to clients or a sense of losing time with clients in order to complete the assessment. Notably, time 2 interviewees were more likely than time 1 interviewees to express the belief that the CIS was developed to improve client care.

The context of community nursing, specifically the independent nature of the work and the decentralized environment, also emerged as a theme related to CIS adaptation. Some nurses indicated that this unique environment made it difficult for them to attend training sessions or to be fully aware that training was necessary or available. Participants found it helpful to practise using the device. Learning was enhanced through sustained messaging at regularly scheduled team meetings.

Characteristics of the device. Characteristics of the device and the assessment tool were less likely to be discussed at time 2. Generally, interview participants commented that CIS provided useful features (e.g., appointment set-up) and was a comprehensive assessment tool, finding it particularly useful for long-term or palliative clients. Management support and the availability of problem-solving tools, especially during network outages, were noted as particularly helpful in encouraging troubleshooting and proper use of the device. Nurses also indicated that they looked forward to future enhancements to the handheld tool, such as the camera function for wound care. Critical reflection on expanded and enhanced use of the device in a clinical setting was not noted in time 1 interviews.

How evidence-based materials are best accessed in a clinical setting through the use of the handheld device was explored during time 2 interviews. Participants discussed a variety of barriers to accessing research during practice, including the limited capabilities of the device (e.g., poor access to Internet in some areas), lacking the time necessary to access the resources, and limited awareness of how or when to use research in daily practice.

Quantitative Findings

User satisfaction with the CIS system. Respondents reported using the CIS system to access clients' records (53.6% at time 1 and 57.1% at time 2), for telephone communication (98.2% and 96.1%), for e-mail (94.6% and 94.8%), for text messaging (66.1% and 70.1%), to access RNAO best practice guidelines (22.5% and 27.3%), to access the McMaster University Nursing Plus literature database (21.2% and 23.4%), and to access "other information resources" (28.3% and 49.4%).

Respondents were moderately satisfied with the overall features of the application (mean 5.02 at baseline and 5.03 at time 2). They were most satisfied with the terminology used throughout the application (6.43 and 6.72) and with the clarity of messages appearing on the screen (6.29 and 6.51). They reported the highlighting on the screen as helpful (5.74 and 6.19) and found the system easy to use (5.98 and 5.76) and easy to learn (6.14 and 6.35). Navigating the system was viewed as moderately easy (5.80 and 5.49) and correcting mistakes as relatively easy (5.77 and 5.19). There was a significant reduction in satisfaction with system speed between time 1 and time 2 ($p < 0.0090$) but a significant increase in satisfaction with having nurses' questions about the CIS addressed ($p < 0.0234$) and the relevancy of terminology to their work ($p < 0.0001$). No other significant differences were noted in usability evaluation.

Regression analysis indicated that the overall user reactions to the CIS were positively associated with ACT organizational structural and electronic resources and ACT social capital and were negatively associated with nurses' age at time 1 (see Table 1). Structural and electronic resources represent elements of an organization that facilitate access to and use of knowledge — for example, providing nurses with access to the Internet or mobile technology to facilitate their access to electronic information. Social capital comprises the informal exchanges between individuals working within an organization that can promote the transfer of knowledge (Estabrooks et al., 2011). Only one significant factor of ACT social capital was positively associated with overall user reactions at time 2 (Table 1).

Change in context for evidence-based practice and research utilization.

Table 2 presents the scores for organizational context, evidence-based practice, and research utilization at times 1 and 2. The score for structural and electronic resources dramatically improved between time 1 (2.86) and time 2 (3.60). However, the score for feedback processes was significantly reduced, from 3.22 at time 1 to 2.94 at time 2. The scores for evidence-based practice and research utilization remained the same or did not show significant difference statistically over time.

Table 1 Regression Analysis			
Response Variable	Variable	Estimate (95% CI)	p value
Overall user reaction	<i>Time 1</i> Nurse age	-0.03 (-0.05, -0.01)	0.0227
	ACT structural and electronic resources	0.17 (0.05, 0.30)	0.0071
	ACT social capital	1.04 (0.46, 1.61)	0.0004
	<i>Time 2</i> ACT social capital	1.24 (0.45, 1.98)	0.0009
Overall research use	<i>Time 1</i> Nurse age	-0.03 (-0.05, -0.01)	0.0044
	<i>Time 2</i> Nurse age	-0.03 (-0.06, -0.00)	0.0301
	ACT feedback	-0.57 (-0.98, -0.17)	0.0050
	ACT formal interaction	0.33 (0.047, 0.61)	0.0206

Table 2 Organizational Context, Evidence-Based Practice, and Research Utilization

Subscale	Time 1		Time 2		t value ^b	p value ^c
	N ^a	Mean (SD)	N	Mean (SD)		
	ACT leadership	117	3.83 (0.74)	80		
ACT culture	117	3.92 (0.56)	80	3.78 (0.62)	1.62	0.1071
ACT feedback	116	3.22 (0.84)	77	2.94 (0.88)	2.12	0.0349
ACT informal interactions	114	1.74 (1.38)	80	2.09 (1.54)	-1.63	0.1038
ACT formal interactions	114	1.56 (1.21)	80	1.78 (1.30)	-1.17	0.2428
ACT social capital	114	3.89 (0.57)	79	3.86 (0.51)	0.48	0.6326
ACT structural and electronic resource	114	2.86 (2.46)	78	3.60 (2.37)	-2.08	0.0388
ACT organizational slack: staff	114	3.21 (1.08)	79	3.17 (1.03)	0.28	0.7768
ACT organizational slack: space	114	3.61 (0.61)	79	3.59 (0.62)	0.27	0.7912
ACT organizational slack: time	114	3.26 (0.70)	78	3.09 (0.64)	1.76	0.0793
Instrumental research use	114	2.89 (1.50)	78	2.76 (1.51)	0.62	0.5328
Overall research use	113	2.61 (1.40)	77	2.61 (1.53)	0	0.9991
Attitude towards research	118	3.85 (0.57)	81	3.95 (0.52)	-1.22	0.2234
Belief willing to implement research	113	3.93 (0.56)	78	3.92 (0.58)	0.04	0.9698

Belief actually implement research	113	3.39 (0.85)	78	3.34 (1.03)	0.37	0.7119
Instrumental research use ("On your last day of work how often did you use research in this way?")	114	2.89 (1.50)	78	2.76 (1.51)	0.62	0.5328
Used research to change practice in past	113	3.68 (0.84)	79	3.76 (0.91)	-0.61	0.5401
Used research to change practice in last 6 months	113	3.73 (0.83)	79	3.65 (0.96)	0.62	0.5376
Intend to use research to change practice in the future	113	3.98 (0.79)	79	3.92 (0.87)	0.48	0.6310

^a Total number of valid (i.e., non-missing) observations used in calculating means.
^b *T* test performed to compare mean at times 1 and 2; a negative *t* value meant score increased from time 1 to time 2.
^c *P*-value less than 0.05 meant that the difference was statistically significant at 0.05 level.

Nurses were asked to rate their research use and their attitude towards using research in practice on a scale of 1 (low) to 5 (high). The majority felt that over the preceding 6 months research had changed their practice (70.8%). Regression analysis showed that younger age was associated with overall research use at both time 1 and time 2. Organizational context of evaluation was negatively associated with overall research use but the influence of formal interaction was positive at time 2 (Table 1).

Discussion

In the discussion that follows, we will address the limitations of the study, examine the key findings, and describe the implications for future research.

Study Limitations and Strengths

The nurse data represented a sample of convenience comprising nurses who volunteered to take part in the study. A cross-sectional sample of nurses responded to the time 1 and time 2 surveys. It was not possible to link individual responses, which would have been useful for assessing change in attitude and research utilization over time. As a result, the use of multiple independent *t* tests increased the chances of a type 1 error. The strengths of the study include the use of multiple methods and multiple data sources, which minimizes threats such as common-method bias, and the use of established reliable and valid measurement instruments, which strengthens the internal validity of the findings.

Study Findings

The findings from this formative evaluation are consistent with those from a recent qualitative descriptive study of CIS implementation, which identified nurse-related, computer-related, and context-related facilitators of and barriers to CIS adaptation (Whittaker et al., 2009). System speed, manager support, timing of training, supportive staff, openness to change, positive outlook, and ease of use were facilitators identified in our study. Our findings suggest that it might be helpful to develop flexible nurse training programs that are designed to meet the needs of individual nurses based on their comfort with and knowledge about the technology.

Usability evaluation revealed that respondents were moderately satisfied with the overall features of the CIS. They were most satisfied with terminology throughout the system and there was a significant improvement over time in their belief that the terminology related well to the work they were doing. User feedback was employed to continuously improve the system throughout the formative phase of develop-

ment. Management support and the availability of problem-solving tools were noted as particularly helpful during the formative stages of implementation.

Successful implementation of information technology systems depends on a variety of factors, such as technical, individual, and organizational (Nowinski et al., 2007). Most of the research has demonstrated that user acceptance is a critical factor in successful CIS implementation (Ammenwerth, Mansmann, Iller, & Eichstadter, 2003). Barriers associated with the user and the organization/environment have been identified (Moody, Slocumb, Berg, & Jackson, 2004). The results of our formative evaluation are consistent with those reported in the literature. The strongest predictor of nurses' adoption of the new CIS was their attitude towards electronic documentation. Notably, access to structural and electronic resources and social capital were conducive to CIS adaptation. Social capital reflects the degree to which people in a group share information with others and participate in group activities, group exchange is focused on helping others do their job, and nurses believe that client conditions are taken seriously by those in authority (Estabrooks et al., 2009). It is possible that social capital in this study supported nurses' learning to use the CIS and also influenced their motivation to adopt the new technology in their practice. Access to structural and electronic resources represents elements within the organization that support nurses' access to knowledge resources, and these were found to be associated with nurses' willingness to use the BlackBerry to document through the CIS. Older nurses demonstrated greater resistance to the CIS than younger nurses. Although Whittaker et al. (2009) do not identify age as a nurse barrier to electronic documentation, they do identify lack of computer experience, which could reflect generational differences in exposure to computers throughout schooling and work life.

CIS implementation was expected to result in a change in the context for evidence-based practice and, in turn, nurses' research utilization. Our findings indicate a significant improvement over time in nurses' access to structural and electronic resources to support evidence-based practice. However, contrary to expectations, the cross-sectional sample at time 2 reported less access to feedback and evaluation than the sample at time 1. One possible explanation for this finding is that expectations may have been raised when the CIS was introduced and after 18 months these were not fully met. At 18 months the agency was in the early phases of implementing a team review of client outcomes and evidence-based practice. It will be important to re-assess nurses' perception of evaluation and feedback processes as the CIS becomes more ingrained in clinical documentation and as nurses gain more experience with team review of client outcomes.

A number of contextual factors have been shown to inhibit evidence-based practice. These include unavailability of support staff, lack of equipment and facilities, and time and resource constraints (Koh, Manias, Hutchinson, Donath, & Johnston, 2008). Heavy workloads, being short-staffed, high patient-to-staff ratios, and high patient acuity have also been identified as barriers to the implementation of best practice guidelines (Koh et al., 2008; Milisen, Geeraerts, Dejaeger, & Scientific Working Party, 2009; Ploeg, Davies, Edwards, Gifford, & Elliot-Miller, 2007). Education and orientation of the guideline before implementation have been identified as facilitators (Egnatios, Dupree, & Williams, 2010). Ploeg et al. (2007) report that learning about the guideline through small-group interaction helped to integrate the guideline into practice and promoted positive attitudes. In the present study, the organization used the strategy of training through online resources, teleconferencing, and hands-on orientation, and respondent feedback underscored the importance of this training in the formative phase of implementation.

Our study focused on the formative phase of CIS implementation. Additional research, currently in progress, is exploring how implementation of the CIS intersects with improved clinical outcomes, client satisfaction, and organizational quality outcomes and will provide a more complete understanding of the impact of CIS implementation. Further research may be needed to determine what nurses' use of electronic devices means for one-on-one interaction between nurse and client.

Conclusion

The integration of electronic resources, assessment protocols, and best practice guidelines has the potential to support evidence-based practice in a community setting. We are on the brink of understanding the barriers, facilitators, and organizational factors that affect adaptation and integration of CIS in home care. This evaluation of implementation of an automated CIS has identified the importance of educational support, user-centred design, and responsiveness in informing CIS implementation and adaptation strategies in home care settings.

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