Adopting a personal digital assistant system: application of Lewin’s change theory

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Accepted for publication 9 December 2005

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doi: 10.1111/j.1365-2648.2006.03935.x

Aim. This paper reports a study exploring nurses’ perceptions of adopting an information system using handheld computers (personal digital assistants) in their daily practice.

Background. Handheld computers have recently been used in nursing information systems for patient care, but few studies have explored their impact on users. By understanding clinicians’ experiences of using this technology, strategies can be implemented to smooth the change process in adopting their use, thus achieving optimal patient outcomes.

Method. A descriptive, exploratory approach was used to study nurses’ perceptions of using personal digital assistants as part of a hospital information system. A purposive sample of 15 nurses participated in one-to-one, in-depth interviews from February to March 2004. Nurses’ perceptions of the adoption process were analysed using Lewin’s force field theory of change as a framework.

Findings. Nurses initially resisted using the personal digital assistant system (unfreezing stage), then came around to using it (moving stage), and finally adopted the system in their daily practice (re-freezing stage). However, an anticipatory stage also occurred and this could serve as a feedback mechanism to improve the system for current and future use.

Conclusion. Educational programmes should be provided and strategic planning should be done in the early stage of implementing a policy to adopt new technology. In addition, the adoption process and learning period could be shortened by improving the system’s content design. During this transition stage, dual charting should be used as a backup only for a limited time to avoid adding extra work to nurses’ already heavy workload. Finally, the concept of confidentiality should be reinforced and stressed early in the educational programme to protect patient data, which can easily be accessed in computerized systems.

Keywords: empirical research report, handheld computers, Lewin’s change theory, nurses’ perceptions, personal digital assistants, qualitative research, technology

Introduction

Wireless access handheld computers, often referred to as personal digital assistants (PDAs), are now commonly used to manage information, especially by healthcare providers at the point of care (McLeod et al. 2003). ‘Wireless access’ implies that the system is always connected and that data can be retrieved in real time, which is appropriate and necessary in health care (Newbold 2004). PDAs have been used to store reference information for prescribing drugs (Johnson et al. 2002, Rothschild et al. 2002) and for laboratory testing (Bissell 2001, Dyer et al. 2001), and to serve as memory aids for brain-injured patients (Wright et al. 2001a, 2001b). A survey of nurses revealed that of those who focused on
information management in health care, approximately one-fourth used their own PDAs for clinical use (Newbold 2004).

While using information systems that interface with PDAs has become popular in health care, few studies have explored the impact of this technology on users. In nursing, only home health nurses’ experiences with wireless, pen-based computers have been reported (Wilson & Fulmer 1997, 1998). Although PDAs have been promoted as portable and easy to use (Enger 2001, Enger & Segal-Isaacscon 2001, Jenkins 2002), no study to date has applied a model or conceptual framework to investigate the adoption process for this technology and how its use affects clinicians’ daily practice. Since the transition process from a manual to an automated system is a tremendous change for nurses, change theory is an ideal framework for understanding clinicians’ perceptions of the impact of using a PDA system. This understanding can be used to design and implement strategies and programmes to smooth the technology adoption process, thereby achieving optimal use for clinical care.

Background

The adoption of mobile technology for health care has raised issues in three major areas: computer hardware and software, personal perspectives, and concerns about confidentiality (Hughes 2003). The following literature review addresses these issues.

Hardware and software issues

Personal digital assistants have many known advantages, such as easy data access, electronic prescribing, electronic charge capture, on-line documentation, wireless synchronization of shared data, and integrating different input and output devices to support workflow (Barbash 2001, Goss & Carrico 2002, Fischer et al. 2003, Lewis & Sommers 2003). Nonetheless, the drawbacks of this technology include cost of hardware (device and maintenance), software fees (design and shareware license), short battery life and small screens for viewing data (Enger 2001, Enger & Segal-Isaacson 2001, Jenkins 2002, Gallagher 2004).

Personal usage issues

The interaction between humans and handheld computers has been examined in many studies. In one study (McManus 2000), the use of PDAs in a healthcare institution was expected to have benefits such as increased time with patients and improved staff professionalism, but these goals were not achieved due to poor system interface design. McManus cautioned that for optimal usage outcomes, administrators need to consider human factors such as eyesight limitations for reading small screens and cognitive overload when searching through many screens to obtain the desired information.

The difficulties encountered by PDA users in clinical settings have also been studied. Wallace and Harrington (2003) found that for non-clinician managers in one hospital where PDAs were used, all respondents admitted having difficulties when they first used PDAs. Furthermore, most of them did not know that on-line information could be downloaded to PDAs, nor that they could ‘beam’ information via infrared transmission from one PDA to another. Thus, while PDAs may not be hard to use, they are often underused.

Nurses’ perceptions of using handheld computers have been explored for documenting home care (Wilson & Fulmer 1997, 1998) and managing intravenous consultation services (Bosma et al. 2003). Although nurses valued the PDA’s assistance in organizing daily practice, retrieving point-of-care information, and integrating with statistical analysis software, these studies reported that nurses experienced obstacles such as fear of losing PDAs or styluses, data transmission problems, software (screen) freezes, hardware breakage and slow responsiveness after entering a large amount of patient data.

Confidentiality issues

The ease with which patient information can be accessed via PDAs has raised issues about confidentiality of patient data (Hughes 2003, Bobula et al. 2004). If a clinician loses a PDA, the confidentiality of patient information might be put at risk. To avoid this problem, it has been suggested that specific patient information not be stored on PDAs (McCord 2003). It has also been recommended that clinicians not store patient data on their PDAs unless the institution has developed functionality and policies to ensure confidentiality of data and data transmission (Tooe & Mayo 2003). To protect information on PDAs, Pancoast et al. (2003) proposed the following precautions: keep physical control of the device, use data encryption, use a password to turn on PDAs, disable infrared ports except during use, and do not send infrared transmissions in public locations.

In addition to the issues reviewed above, the adoption of mobile technology for health care involves changes in workflow. As technological change becomes an increasingly common occurrence in the healthcare environment, change theory offers one way of understanding the dynamic interaction by which individuals adapt to change.
Lewin's force field or change theory

Lewin’s (1951) theory posits that change occurs in three stages: unfreezing, moving and refreezing. Unfreezing involves motivating individuals by getting them ready for change, moving involves encouraging individuals to adopt a new perspective that enables them to perceive that the current situation can be improved, and refreezing involves reinforcing new patterns of behaviour. In the unfreezing stage, the forces driving towards and restraining individuals from adopting a change must be identified. Strategies should be devised to strengthen the driving forces and to weaken the restraining forces. In the moving stage, open communication and participation in developing the change in perspective should be encouraged. Once individuals feel actively involved and personally committed to a project, they will be more likely to support its successful implementation. In the refreezing stage, the change is maintained by providing continued assistance and support to people using the system (Lewin 1951).

Lewin’s theory has been proposed as a framework for planning, implementing, and evaluating the acceptance and success of a nursing information system (Bozak 2003). To assist nurses in the transition from a paper documentation system to an electronic one, Bozak suggested several strategies to strengthen the driving forces and to overcome the restraining ones. While Lewin’s change theory has been suggested as a guideline for analysing this change process (Bozak 2003), no study has applied this theory in clinical situations.

The study

Aim

The aim of this study was to use for exploring nurses’ perceptions of adopting a PDA system in their daily practice. The research question was, ‘What are nurses’ perceptions of the change process (adopting a new technology) in using PDAs in their daily practice?’

Design

A descriptive, exploratory qualitative approach with in-depth interviews was used to study nurses’ perceptions of adopting a PDA system. Lewin’s force field theory was used as the theoretical framework. The data were collected in 2004.

Study setting

The study was conducted at a 600-bed medical center in Taiwan. This hospital implemented the PDA system in January 2002 for electronic charge capture as the first step in computerizing the patient record system, and it has been available in most inpatient units ever since. At the time of this study (see below), nurses were required to use the PDA for charge capture and charting patient intake/output (I/O) records. Nurses had to download patient data from the unit’s personal computer (PC) to individual PDAs.

The designated PDAs, which were 5.1 x 3.3 x 0.6 in and weighed 6 oz, used the WinCE 3.0 (Microsoft Corporation, USA) operating system and had a colour display. They used a lithium battery with 14-hour capacity, 32 MB random access memory, and 16 MB read only memory. Each unit had six to seven PDAs (depending on unit size), which were used for three different shifts and kept as unit property. Once the charge or charting was complete, nurses uploaded the data from the PDA to the unit PC. Nurses then verified the uploaded data on the PC to complete the documentation process.

Participants

A sample of 15 nurses took part in the study. All participants were purposively recruited from inpatient units where PDAs were used for daily charge capture and charting of I/O records. Potential participants volunteered in response to an introductory letter that was posted in these units. The letter explained the study purpose and procedures. The inclusion criteria were that participants must be Registered Nurses who had worked in the unit and used the PDA system for at least 3 months. It was assumed that after 3 months nurses would understand the unit’s routine care and operations related to PDA use, and would have developed perceptions about integrating the technology into their work.

Of the 15 participants, five were 20–25 years old, six were between 26 and 30 years, and the remaining four ranged from 31–40 years. Eight had a baccalaureate nursing degree, and the rest had a vocational nursing degree. Five had less than 3 years’ nursing experience, five had more than 3 but less than 6 years’ experience, and the remaining five had 6 or more years’ experience. Ten had used computers in their previous jobs.

Data collection

Data were collected by semi-structured, in-depth interviews undertaken from February to March, 2004. All interviews took place in a reserved conference room at the participant’s work unit. Each nurse was interviewed once, before or after work hours. Interviews, which lasted between 30 and 45 minutes, were tape recorded and transcribed verbatim, and were guided by the following questions: ‘What do you think about using a PDA in your practice?’, ‘What specific experiences did you
have in the process of adjusting to PDA use?’ and ‘What would you suggest to smooth this process in the future?’

Ethical considerations

The study was approved by the Institutional Review Board at the medical centre where participants were employed. Signed informed consent was obtained before interviews, and privacy and anonymity were guaranteed. After each interview, participants were asked for demographic information (i.e. age, education, job title, computer and nursing experiences). To express gratitude for nurses’ participation, they were given a small gift after the interview.

Data analysis

Data analysis was based on procedures proposed by Miles and Huberman (1994), including data reduction, data display and conclusion drawing. First, the raw data (participants’ descriptions of their experiences) were open coded, line by line. Incidents or themes were identified in each transcript and compared with those of other transcripts. Comparison and contrast of transcripts were based on similarities or differences (so-called data reduction). Since the purpose of this study was to analyse nurses’ perceptions of the change process in adapting to PDA use, specific attention was paid to behavioural or attitude changes. The identified representative concepts or themes were arrayed either in tables or diagrams to indicate patterns or relationships among themes (data display). Finally, major concepts were abstracted and themes were categorized from the content of these tables and diagrams to draw conclusions about the nurses’ perceptions (conclusion drawing).

Rigour

To ensure trustworthiness of the qualitative data, methods were applied to increase rigour by ensuring fittingness, credibility and auditability (Sandelowski 1986). First, all transcripts were reviewed by participants before data analysis (member check) to ensure data accuracy. Fittingness of the findings was addressed by purposively recruiting nurses who practised in inpatient units where PDAs were used and who could articulate their perceptions. Credibility was enhanced by including numerous quotes from participants’ verbal descriptions in the findings of this study. Auditability was demonstrated by having another nurse researcher with expertise in qualitative research review the interview content, emergent themes and categories to ensure the objectivity of data analysis.

Findings

Central themes from participants’ perceptions of using PDAs, their relationship to Lewin’s change stages, and supporting interview content are summarized in Table 1.

Unfreezing stage: resistance to inconveniences or usage difficulties

Nurses encountered many inconveniences when they first used the PDA. For example, hospital policy required them to chart on PDAs but to keep charting manually as backup documentation. This dual charting added another task to the nurses’ busy schedule. One said, ‘After charting on the PDA, we still have to chart on the I/O sheets for doctors to read. It’s a waste of our time and adds to our workload’ (RN1).

Nurses also complained about the training process to use the PDA. One said,

We sent nurses to be trained [to use the PDA] and then they came back to teach others. However, the class was so short that you had to learn by trial and error. Thus, when you kept trying and losing data, you didn’t want to use it anymore. (RN2)

Another commented about the inconvenience of using PDAs:

Sometimes you need to go through many screens to get what you want. For example, it [the PDA] is only designed to chart two drain tubes. If a third one is needed, you have to find out how to do it. (RN3)

Furthermore, the PDA system had technical problems at first. Some nurses described feeling panic:

We had unexpected problems, such as numbers and charting times changing after data transmission, long response time, and finding out after you’d been charting for awhile that the memory was so full that what you did was not saved. (RN4)

In addition, the PDA weight and short battery life made nurses not want to take it to the bedside:

It [the PDA] is too heavy to carry for patient care. I am afraid that I might drop it, break it or lose it. Not to mention the battery goes out after a short time. Although it gets fully charged in the morning, it goes down to 30–40% by the afternoon. I am afraid of losing data while charting due to low battery. (RN5)

Moving stage: coming around to use the system

Despite all the perceived inconveniences and difficulties imposed by using the PDA, nurses came around to use the system and developed strategies to adapt:
Table 1  Themes in nurses’ perceptions of adapting to personal digital assistant (PDA) use

<table>
<thead>
<tr>
<th>Stage of change: Theme</th>
<th>Examples from participant interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfreezing: Resistance to inconvenience or usage difficulties</td>
<td></td>
</tr>
<tr>
<td>Dual charting adds work</td>
<td>After charting on the PDA, we still have to chart on the I/O sheets for doctors to read. It’s a waste of our time and adds to our workload (RN1)</td>
</tr>
<tr>
<td>Insufficient instruction</td>
<td>We sent nurses to be trained [to use the PDA] and then they came back to teach others. However, the class was so short that you had to learn it by trial and error. Thus, when you kept trying and losing data, you didn’t want it to use it anymore (RN2)</td>
</tr>
<tr>
<td>Inconvenience of using PDAs</td>
<td>Sometime you need to go through many screens to get what you want. For examples, it [the PDA] only designed to chart two drain tubes. If a third one is needed, you have to find out how to do it (RN3)</td>
</tr>
<tr>
<td>Initial technical problems</td>
<td>We had unexpected problems, such as numbers and charting times changing after data transmission, long response time, and finding out after you’d been charting for a while that the memory was so full that what you did was not saved (RN4)</td>
</tr>
<tr>
<td>Device problems</td>
<td>It [the PDA] is too heavy to carry for patient care. I am afraid that I might drop it, break it or lose it. Not to mention the battery goes out after a short time. Although it gets full charge in the morning, it goes down to 30–40% by the afternoon. I am afraid of losing data while charting due to low battery (RN5)</td>
</tr>
<tr>
<td>Moving: Coming around to use the system</td>
<td></td>
</tr>
<tr>
<td>Practice makes familiarity</td>
<td>I think practice brings familiarity. We seldom use the [paper] I/O sheet in our unit and that’s why we don’t think it [using the PDA] was easy to do the beginning. But if we use it all the time, it is not so hard to chart on the PDA (RN6)</td>
</tr>
<tr>
<td>Accept change as a policy requirement</td>
<td>I was hoping that the PDA would go away when everyone complained about its drawbacks. But it stayed and became one of our required tasks. Now that I understand it’s part of our workflow, I won’t resist it anymore (RN5)</td>
</tr>
<tr>
<td>Involvement in design process</td>
<td>I was involved in the design process, so it was no problem for me to use it [the PDA] at all. I also understand that the paper system will phase out, and the dual charting is temporary (RN6)</td>
</tr>
<tr>
<td>Incentives to use system</td>
<td>The PDA usage frequency in nursing units is announced every month. I don’t want our unit to look inferior to others by showing up at the bottom of the list, so I try my best to use it (RN4)</td>
</tr>
<tr>
<td>Use extra time to deal with PDAs</td>
<td>I used to come to work early to download patient data just in case there were patients to be transferred or discharged and they needed to be charged immediately (RN4)</td>
</tr>
<tr>
<td>Re-freezing: Working with PDAs</td>
<td></td>
</tr>
<tr>
<td>Time-share use</td>
<td>We take turns transmitting PDA data to avoid rush hours, which could slow down the system response time. But if you are busy and have no time to download, key-in, upload and verify data, we take notes [on paper] and then chart directly to the PC. It is faster and much easier (RN7)</td>
</tr>
<tr>
<td>Change workflow</td>
<td>It is very convenient for the system to automatically sum up the I/O. However, the cutoff point is at 8 am, and the shift changes over at 7 am, so we count any I/O volume that occurs after 7 am on the next day. Furthermore, since there is no column for decimals, we wait to chart small volumes of a medicine or fluid until it reaches an integer (RN9)</td>
</tr>
<tr>
<td>Relying on the PDA</td>
<td>Sometime you rely on the PDA so much that you don’t read all the details. You may charge a wrong item due to similar spelling (RN8)</td>
</tr>
<tr>
<td>login/logout problems</td>
<td>Patients’ data can be stored in different PDAs, but you can check them using the nurse’s ID from the previous shift if she did not log out. Many nurses won’t bother to log in and log out just to check data. However, I will log out for others and use my own login ID, but I won’t bother to log out after use (RN4)</td>
</tr>
<tr>
<td>Saving charge for the last task</td>
<td>I always save the charge to the last when patient care is finished. I can recall in detail what I have done for patients so I won’t lose or miss charting and the charge capture is complete (RN4)</td>
</tr>
<tr>
<td>Anticipatory stage: wish lists</td>
<td></td>
</tr>
<tr>
<td>No dual charting</td>
<td>I don’t think dual charting is needed. If you think that charges are missing on PDAs, they could be missing on paper as well. (RN10)</td>
</tr>
<tr>
<td>More PDA functions, a PDA for each nurse</td>
<td>I would like it [the PDA] to have voice recognition, to weigh less for better portability, for each nurse to have her own PDA, and enough PCs to upload data. I also think that a brighter screen would be helpful to read on the night shift (RN4)</td>
</tr>
<tr>
<td>More features besides charting</td>
<td>I wish it had ditto function and could beam data [infrared transfer]. There should be more features than just charge capture or charting I/O, such as documentation for wound assessment or clinical path (RN11)</td>
</tr>
<tr>
<td>Concern about job security</td>
<td>Here’s what I learned from this technology: if your eyesight or physical condition has deteriorated too much to work with a PDA at night, you may want to consider another career (RN5)</td>
</tr>
</tbody>
</table>

RN, Registered Nurse; I/O, intake/output; PC, personal computer; ID, identification.
I think practice brings familiarity. We seldom use [paper] I/O sheets in our units and that’s why we didn’t think it [using the PDA] was easy to do at the beginning. But if we use it all the time, it is not so hard to chart on the PDA. (RN6)

Nurses who believed that change is inevitable and finally accepted the system expressed a similar attitude:

I was hoping that the PDA would go away when everyone complained about its drawbacks. But it stayed and became one of our required tasks. Now that I understand it’s part of our workflow, I won’t resist it anymore. (RN5)

Moreover, a positive attitude was shown by some nurses who had been involved in the design team and had learned earlier than the others how to take advantage of the PDA’s usage functions:

I was involved in the design process, so it was no problem for me to use it [the PDA] at all. I also understand that the paper system will phase out, and the dual charting is only temporary. (RN6)

The hospital also used some strategies to increase nurses’ incentives to use the PDA. For example, PDA usage frequencies on each unit were posted as a monthly report:

The PDA usage frequency in nursing units is announced every month. I don’t want our unit to look inferior to others by showing up at the bottom of the list, so I try my best to use it. (RN4)

Some nurses learned to use the PDA on their own time. As the same nurse explained:

I used to come to work early to download patient data just in case there were patients to be transferred or discharged, and they needed to be charged immediately. (RN4)

In talking about how she managed this change phase, this same nurse said:

Because I am a new nurse, my first priority is to get to know the work setting. The PDA is something I can learn after work at my own pace. So I spent extra time on it [the PDA] during that period just to familiarise myself with the system. (RN4)

Re-freezing stage: working with PDAs

While the system’s features were not designed for nurses’ needs, they developed ways to integrate PDA use into their daily practice:

We take turns transmitting PDA data to avoid rush hours, which could slow down the system response time. But if you are busy and have no time to download, key-in, upload and verify data, we take notes [on paper] and then chart directly to the PC. It is faster and much easier. (RN7)

Moreover, nurses changed their workflow to adjust to difficulties using the PDA:

It is very convenient for the system to automatically sum up the I/O. However, the cutoff point is at 8 am, and the shift changes over at 7 am, so we count any I/O volume that occurs after 7 am on the next day. Furthermore, since there is no column for decimals, we wait to chart small volumes of a medicine or fluid until it reaches an integer. (RN9)

Since the PDA system was designed to ease nurses’ workflow, some admitted relying on listed items and tending to click on the screen (point-and-click) without paying sufficient attention to the content. One commented: ‘Sometimes you rely on the PDA so much that you don’t read all the details. You may charge a wrong item due to similar spelling’ (RN8).

When asked about providing continuous care by obtaining patient information from the PDA system, the notion of data confidentiality seemed to be ignored:

Patients’ data can be stored in different PDAs, but you can check them using the nurse’s ID from the previous shift if she didn’t log out. Many nurses won’t bother to log in and log out just to check data. However, I will log out for others and use my own login ID, but I won’t bother to log out after use. (RN4)

Some nurses preferred to postpone documentation until the end of the shift:

I always save the charge to the last when patient care is finished. I can recall in detail what I have done for patients so I won’t lose or miss charting, and charge capture is completed. (RN4)

Anticipatory stage: wish lists

Many nurses commented at this stage that using PDAs posed no problem for them. However, when asked what they thought would help to streamline their workload, most asked to eliminate dual charting. One said: ‘I don’t think dual charting is needed. If you think that charges are missing on PDAs, they could be missing on paper as well’ (RN10).

Others had a wish list for added PDA features:

I would like it [the PDA] to have voice recognition, to weigh less for better portability, for each nurse to have her own PDA, and enough PCs to upload data. I also think that a brighter screen would be helpful to read on the night shift. (RN4)

I wish it [the PDA] had ditto function and could beam data [infrared transfer]. There should be more features than just charge capture or
A few nurses expressed concern that technology use might affect their job security:

Here’s what I learned from this technology: if your eyesight or physical condition has deteriorated too much to work with a PDA at night, you may want to consider another career. (RN5)

Discussion

The study findings indicate that nurses went through different change stages in adapting to PDA usage, but their resistance to change occurred while they were using the PDA and not when they anticipated its coming use. In addition, education programmes on PDA use seemed insufficient, since nurses complained about problems using PDAs and they were unaware of the concept of data confidentiality. Finally, the study revealed an additional stage in the change process: an anticipatory stage to refine the PDA system for current and future use.

In Lewin’s theory, the unfreezing stage involves perceiving a change and deciding whether to accept or reject it. However, in the real world of health care, employees usually do not have much say in policy implementation. A study of factors affecting the adoption of an electronic medical record system found that staff was required to use the new technology, whether or not they liked it (Lee 2000). Not until the nurses in the present study encountered difficulties using PDAs did resistance appear and decrease their work efficiency. Therefore, as others have emphasized, it is important to train and educate staff to understand how and why to use the new technology applications (McManus 2000, Lee et al. 2002). In addition, the design of technology applications (such as nursing information systems) should be user-friendly for clinicians (McAlearney et al. 2004). In the present study, a more thorough development of PDA content and more hands-on practice using PDAs would have helped smooth the initial chaotic stage of the change process.

Involving staff nurses in the implementation of new technology systems is vital in the change process, but they might still resist due to concerns about intrusions into their normal way of performing activities (Bozak 2003). While resistance may be a coping mechanism to protect against the instability brought by change, interventions could be applied to promote acceptance of innovation (Schoolfield & Orduña 2001). In the current study, nurses did show resistance when they encountered difficulty using the PDA system. Nonetheless, after the policy to use it had been consistently implemented throughout the organization, and users’ feedback was used to repair and improve the system, nurses were willing to use the system as their voices had been heard by administrators. Furthermore, an incentive strategy was applied (posting usage frequency), which certainly increased nurses’ motivation to learn to use the PDA in their spare time.

While nurses learned how to adopt the PDA system into their daily practice (e.g. using ‘time-sharing’ to avoid slow system response time during rush hours), other issues also emerged. For example, nurses took shortcuts by charting directly on the PC, counting their I/O amount at 7 am instead of 8 am, or waiting for fluid volumes to reach an integer before charting them. This finding reflects how nursing practice is influenced by technology, which could sometimes make nursing practice more demanding, time-consuming and distracting (Barnard 2000). Therefore, others have suggested that clinical workflow should be redesigned when introducing an innovation such as an information system to alleviate workload or streamline nurses’ routines (Miranda et al. 2001, Lee et al. 2002). Although features of the PDA system, such as data transmission time, were improved after nurses complained, they still had to modify their work patterns in adapting to the system. Some of these modifications (e.g. charting directly on the PC to avoid the data transmission process, and charting volumes as integers) could be solved by other alternatives to improve work efficiency. Technology is more likely to be used when potential users perceive that its use is compatible with established work activities and brings clear results (Hughes 2003).

Another issue raised by the findings is data confidentiality. Nurses generally did not seem concerned about the importance of using personal IDs to log into the system. They routinely left the system without logging out, which could jeopardize patient data by allowing access by unauthorized persons. This finding was conveyed to managers at the study setting before completing data collection, resulting in a change of the educational programme to emphasize user liability and confidentiality of patient data. Although the system currently does not keep patient data in PDAs for more than 24 hours, protecting patient privacy through instant access is still a vital concept that needs to be taught and integrated into the technology adoption process (Jenkins 2002, McCord 2003, Gallagher 2004).

Although Lewin proposed three main stages for the change process – unfreezing, moving and re-freezing – our findings suggest adding a fourth stage: ‘anticipatory stage’. This stage is based on a summary of participants’ wish lists after the third stage. In a retrospective view of this change process, nurses wished that the next step in PDA use (most likely to chart vital signs) would not have a dual charting requirement.
What is already known about this topic
- Using computers has become a trend in healthcare organizations to streamline workflow and to improve patient care quality.
- Personal digital assistants have been used to prevent prescription or medication errors, efficiently retrieve data, and collect data.
- Lewin’s change theory has been suggested as a framework for explaining attitudes and reactions towards change processes.

What this paper adds
- Educational programmes should be provided and strategic planning should be done in the early stage of implementing a policy to adopt new technology.
- The adoption process and learning period could be shortened by improving the system’s content design, and during this transition stage dual charting should be used as a backup only for a limited time to avoid adding to nurses’ workload.
- The concept of confidentiality should be reinforced and stressed early in the educational programme to protect patient data, which can easily be accessed in computerized systems.

Although administrators see dual charting as a backup to save patient data during the transition from manual to computerized documentation, nurses view this process as time-consuming and meaningless (Miranda et al. 2001, Lee et al. 2002). The dual charting requirement also sent a message that administrators did not trust nurses’ charting, which made them wonder whether adapting to the new system was worth their effort.

In this anticipatory stage, nurses wished that PDAs had more or better characteristics to streamline their work, such as lighter weight, longer battery life, infrared beam data transmission, and functions other than charting (such as wound assessment and documentation). Some also wished that each nurse could have their own PDA to use, as doctors did. As computers are increasingly used in health care and the public have more access to technology applications such as PDAs and mobile phones, computer technology may not be an innovation for nurses but may become a versatile tool in alleviating and streamlining their workload.

Nonetheless, the massive adoption of technology may also be perceived as a threat to the job security of those who are not familiar with these products. While Robinson (2003) emphasized that technology cannot replace compassion in health care, the challenges of using the PDA system (e.g. having to go through many screens to process data, dimly lit screens) caused some nurses in this study to reconsider their careers. A more user-friendly interface design would alleviate this problem.

Implications for nursing
The healthcare environment is dynamic, constantly changing, including the use of technology. The proposed ‘anticipatory stage’ provides a feedback mechanism for improving current and future technology use, thus enhancing both user satisfaction and workflow efficiency. This stage takes into account nurses’ responses to the current system and gives rise to anticipation about its future use, thus preparing nurses for further changes.

In this retrospective study, nurses’ overall experiences of using a specific technology during the initial phase of adopting a hospital information system were analysed. As with all qualitative findings, the interpretation of these results should take into consideration the healthcare setting, design of the technology system, and users’ individual perceptions. Several future studies are suggested. First, because experience is subjective, it can change with time or as technology evolves. Thus, a longitudinal study targeting different change stages may be necessary to explore nurses’ responses to using technology.

Secondly, since changes in individual behaviour occur in the context of a particular environment (Lewin 1951), organizational factors cannot be ignored. Factors such as management style and organizational culture need to be taken into consideration when interpreting individual behaviours. Last, Schoolfield and Orduña (2001) suggest that Lewin’s theory explains little of the emotions and motivations of everyday performance, and that more attention should be given to cognitive or psychological variables to explain the change process. After all, given the beauty of PDA technology’s portability and instant Internet accessibility, studying its use would benefit most healthcare providers and patients.

Conclusion
Nurses did not encounter difficulty until they first used the PDA system, corresponding to the unfreezing change stage. Thus, educational programmes should be provided and strategic planning should be done in the early stage of implementing a policy to adopt new technology. In addition, since nurses took some time to master using the PDA system
and to develop strategies for using the technology in their daily routine, the adoption process and learning period could be shortened by improving the system's content design. During this transition stage, dual charting should be used as a backup only for a limited time to avoid adding extra work to nurses’ already heavy workload. Finally, the concept of confidentiality should be reinforced and stressed early in the educational programme to protect patient data, which can easily be accessed in computerized systems.

Acknowledgement
This study was sponsored by a grant from the National Science Council of the R.O.C. (NSC-93-2520-S-227-001).

References


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