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Conditions for the Successful Implementation of Computer-Aided Drug Monitoring From Registered Nurses' Perspective—A Case Site Analysis

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This research addressed the introduction of a computerized decision support system for drug monitoring to be used by registered nurses in nursing homes. The system was introduced, and its effects were evaluated over the period of 1 year; however, at the end of 1 year, the implementation was not successful in all the participating settings. The aim of this study was to identify the conditions needed for the successful implementation of a computerized decision support system from the registered nurses' perspective. Two case sites were purposively selected based on the implementation's success in one nursing home, but not in the other. Focus group discussions were performed, one in each setting, with eight registered nurses. An inductive thematic analysis was conducted. The findings revealed six themes illustrating the registered nurses' views about the conditions needed: need to see benefits, have the time and take the time, curb administrative hassle, collaboration at all levels, stated responsibility, and requirements set from managerial positions. The most outstanding findings, when compared with the previous implementations of nursing informatics, involved collaboration and the view of drug monitoring responsibility in relation to themselves and the physicians.

KEY WORDS: Decision support system, Drug monitoring, Implementation, Nursing informatics, Qualitative

INTRODUCTION

Nursing Informatics in Elder Care

Nursing informatics refers to how nursing, computer technology, and information science are integrated to improve the quality of care.[1] Registered nurses (RNs) utilize informatics to undertake a range of activities, including accessing clinical databases and electronic patient records, and communicating with their patients and other healthcare professionals.[2,3] One emerging theme in nursing informatics is the use of a computerized decision support system (CDSS),[1] which may refer to alerts, reminders, or algorithms that guide evidence-based care.[4] Nurses use CDSS to record information, monitor patient progress, and confirm treatment decisions with increasing frequency.[5] However, despite the growing awareness of the quality improvement effects of incorporating informatics into the nursing workflow, it remains less commonly used in elder care than in acute care and hospital settings.[4,6] In general, elder care settings are considered to be falling behind other healthcare providers in the adoption of informatics,[7] and few studies of nursing informatics have been conducted in these settings.[1]

Computerized Decision Support Systems for Medication Monitoring

Drug management is an area in which CDSSs are increasingly utilized. Drug-related problems (DRPs), such as adverse drug reactions and the prescription of inappropriate drugs, occur commonly in elder care.[8,9] Moreover, the residents in nursing homes are among the most frail, and they often have multiple medical conditions, undergo extensive drug treatments, and suffer from physical and cognitive impairments, which contribute to a higher risk of DRPs.[10] The detection of DRPs in this population is a time-consuming process that depends on the skills of the professionals involved. Relying on the healthcare professional (mainly physicians) with regard to drug safety is not sufficient, emphasizing the need to use a CDSS in this process.[10,11] The available studies in this field have focused mainly on the use of CDSSs from the perspectives of the prescribers and pharmacists.[12,13] However, a CDSS could also help RNs, who screen for DRPs in their daily clinical practice.[14–16] A CDSS can provide drug-related facts, such as information about unsuitable medications and drug-drug interactions, and allow targeted observations of adverse effects, which can contribute to the detection and reporting of adverse drug reactions.[16–19] Despite the fact that CDSSs have the potential to help support RNs in

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addressing DRPs, there is a lack of reports on the implementation of such systems and their use by RNs in the literature.

Computerized Decision Support System Implementation

In general, the attributes previously identified for the successful implementation of a CDSS for RNs in nursing care involve the organizational environment and the technology itself, including ease of use and possible malfunctions. The patient-related factors, such as relevance and risks, have been described, as have nurse-related factors involving interactions between the RNs and the CDSS, such as resistance to computer use and adequate training.[3,5,20–23] However, CDSSs vary substantially when applied in different contexts; therefore, there is a need for studies focusing on the particular uses of a CDSS, instead of merely providing a general perspective.[24] A growing number of studies have reported barriers and facilitators encountered when introducing and implementing new technology to support RNs in clinical practice. Still, the studies focusing on CDSS use by RNs in elder care are sparse, particularly in the field of drug monitoring. Important roles are played by RNs in ensuring drug safety in elder care settings,[25] and a CDSS has the potential to provide support, which suggests that it is of interest to explore the implementation of such systems. Accordingly, the aim of this study was to identify the conditions required for the successful implementation of a CDSS to be utilized by RNs for drug monitoring.

METHODS

A qualitative multiple case study design was used, which is appropriate when the intention is to investigate contextual conditions of the phenomena under study. In addition, a multiple case study allows the researcher to explore differences between cases.[26,27] The cases in this study consisted of two nursing homes, one in which the CDSS was successfully implemented and another in which it was not. Focus group discussions were used to elicit the RNs' attitudes and perceptions.[28] This study was approved by the Regional Ethical Review Board Uppsala (Dno. 2013/488).

Setting and Process

This study was part of a research project about RNs' roles in pharmacovigilance. The original study was carried out in 2015–2016 in conjunction with the introduction and evaluation of a CDSS used by RNs for drug monitoring and reviews. The CDSS was then introduced and evaluated in four nursing homes during a period of about 1 year. The process was the same in the two settings included in this study, consisting of introductory meetings with the RNs who were to be trained in the use of the CDSS and thereafter provided with support throughout the study period. The implications were evaluated in terms of the number of DRPs detected and the changes in the quality of the drug treatments. Only minor effects were found in the quality of drug treatment 3 and 6 months after implementation of the CDSS.[29] At the end of the study period, the CDSS had been successfully implemented in two of the nursing homes, implying that the RNs adopted use of the CDSS in their clinical practice. In the other two nursing homes, the RNs did not continue to use the new technology. The question arose regarding why the CDSS was not adopted in all of the nursing homes, despite the similar preconditions. Thus, two of the nursing homes in which the RNs were most active in their use of the CDSS during the original study, representing successful and unsuccessful implementation processes, were selected for this study. These two nursing homes had units for both elder care and dementia care, and they housed approximately 40 and 80 residents, respectively, or 120 altogether. Both nursing homes were run by nonprofit community services.

COMPUTERIZED DECISION SUPPORT SYSTEM

The CDSS introduced in the settings was a Web-based decision support system designed for use by healthcare professionals for drug prescribing and reviews. This system retrieves patient-specific information from the available medication lists, electronic medical records, and symptom assessments, and then provides quality reports based on the indicators compiled from national and local recommendations and guidelines for the treatment of persons 75 years of age and older. The quality reports provide information about inappropriate drugs, potential drug-drug interactions, contraindications, and possible adverse drug reactions, all in relation to each individual patient. At the nursing homes, the CDSS was only used by the RNs. It was used mainly in relation to performing drug reviews, which are required according to Swedish regulations. The RNs collected the required data, performed all of the CDSS registrations, and provided the physicians with reports in connection with the drug reviews, whereupon the necessary drug adjustment could be made.

Participants and Data Collection

In Sweden, RNs undergo a 3-year university education. Although they collaborate with unlicensed personnel, they carry the principal responsibility for nursing care. The RNs do not prescribe medications, but they distribute, monitor, and evaluate the treatments in collaboration with unlicensed personnel. Four RNs were working in each of the two nursing homes, while the physicians (one in each nursing home) were situated at distant healthcare centers. All the RNs participated in the study; therefore, it included seven women and one man, with a median age of 45 years (range, 32–62 years). These RNs had a median of 11 years (range, 3–22 years) of nursing experience, of which 4 years (range, 1–11 years) were spent at the nursing homes in the study. Two focus

group discussions were conducted, one in each nursing home. The discussions were moderated by the author, who has experience and training as a moderator, and they lasted for 35 to 45 minutes. An interview guide with open-ended questions was used.[28] The introductory question invited the RNs to brainstorm about their daily work activities involving drug monitoring and reviews. The transition questions involved their experiences while using the CDSS during the study period, as well as the differences when compared with their previous routines. The key questions focused on the hindrances and conditions required for the successful implementation of a CDSS for monitoring drugs in nursing homes. The discussions were recorded and transcribed verbatim by the author.

Analysis

The focus group discussions were analyzed using inductive thematic analysis with a semantic approach, as described by Braun and Clarke.[30] The six phases consist of familiarizing with the data, generating initial codes, searching for themes, defining and naming themes, and finally producing the report. Accordingly, the transcribed text was initially read and reread in order to capture the features associated with the research topic. Sentences and paragraphs that were assessed as interesting or meaningful in relation to the phenomena under study were identified and marked, and the initial codes were systematically generated across the entire data set. The codes were then grouped together into potential themes. The relevance of the themes was checked in relation to the codes and the entire data set, so that finally, clear definitions and names for each theme could be identified. The analysis resulted in six overall themes (Table 1).

RESULTS

Six themes illustrated the RNs' views on the conditions needed for the successful implementation of a CDSS for drug monitoring.

Need to See Benefits

There must be a purpose for the CDSS; that is, the use has to yield results. The quality reports generated need to be thoroughly reviewed to make improvements to the medication process. Moreover, the adjustments made should somehow benefit the patients. Some of the RNs reported that the use of narcotic drugs had decreased after implementation of the CDSS and that they could identify inappropriate drugs and drug combinations more easily, which they considered beneficial for the patients. Improvement in working routines was another benefit, including easier drug review procedures and time savings. Some of the RNs reported that the greatest benefit was reduced time compared to previous routines used for drug reviews.

Have the Time and Take the Time

The physicians need to engage in the process of using the CDSS. They need to take time to audit and assess the quality reports generated. The RNs suggested that the physicians spend enough time in the nursing homes to conduct structured drug reviews. Some of the RNs reported that the physicians' lack of time and, sometimes, interest prevented them from working with the CDSS as intended. More time also implies that the RNs should have opportunity to bring up questions and discuss any drug-related issues with the physicians.

State the Responsibility

The RNs' perceptions of their own responsibility affected the implementation. Some of the RNs stated that the physicians need to request that RNs use the CDSS for drug monitoring. They argued that the physicians are ultimately responsible for the patients' treatments, so the interest and requirements must come from them. Other RNs spoke more in terms of "we need to get the physicians involved in the use of the CDSS." They suggested that the RNs themselves must be interested, committed, and motivated to use the CDSS for drug monitoring. Some of the RNs emphasized the fact that the motivation for using the CDSS is the desire to do what is best for the patients, so that their treatments will be as safe as possible. Therefore, all available tools should be used to accomplish this.

Collaboration at All Levels

Interprofessional collaboration is necessary for the successful implementation of a CDSS for drug monitoring. Although this occurs primarily between the RNs and physicians, support from unlicensed personnel is also essential. This was expressed as "the entire chain needs to be synchronized." The collaboration also extends to management, who, according to the RNs, must be committed and driven in the change process. Collaboration is as much about planning and establishing routines for how and when to use the CDSS. Some RNs suggested that routines need to be established in order to facilitate the implementation process. This lowers the risk that use of the CDSS will be perceived as burdensome.

Staff continuity facilitates collaboration and implementation. From the RNs' perspective, it is important that all RNs are working toward the same goal and continuously supporting each other. Continuity also applies to their relationships with patients, so that the RNs always manage the drug reviews of patients for whom they are responsible. The RNs explained that continuity is also essential among the physicians; however, some suggested that the CDSS would be even more useful for the temporary physicians

Table 1. Analysis Process

Data extract	Coded for	Theme
"You feel that you want a purpose to go with it. Not that we gather a lot of information, which we give to the physicians, and nothing happens, I want a response..." (N2)	Want a purpose	The need to see benefits
"It is time-saving [using the CDSS]" (N1)	Saves time	
"More time, for the physicians and us, to have more time together..." (N2)	Have time together	To have the time and take the time
"If there was more time we would probably question more..." (N2)	Time to question	
"The manager acknowledges that we need to do this, we have to set aside time for it" (N1)	Set aside time	
"To win over the reluctance to learn another system, to enter it... and the technical difficulties" (N2)	Reluctance to learn new systems	To curb administrative hassle
"I believe many think it's a burden [to start using the new system], that is probably the first step... I think that is the biggest obstacle to get past" (N1)	Additional burden	
"If I use a system and I want to enter another one, then I need to log out from that system and log into the next... it's really tiresome" (N2)	Tiresome administrative routines	
"Those who know the patients best are the unlicensed personnel, you need support from them too" (N2)	Collaboration with the unlicensed personnel	To collaborate at all levels
"We have the manager with us as well" (N1)	Managers' support	
"We are a small stable group of nurses working in the same direction" (N1)	Supporting each other	
"It probably has to come from the physician, and he decides that he wants to work like this" (N2)	Physicians' responsibility	To state the responsibility
"You need to get the physicians with you, so that the physician is aware of why drug reviews need to be conducted" (N1)	We need to involve the physicians	
"Maybe it should be impossible to renew any medication or make any changes at all before ticking a box showing that a drug review was made" (N2)	Forced use	To set requirements from managerial positions
"Physicians do not have the time to carry out drug reviews... it is up to their bosses" (N2)	Give the prerequisites	

Abbreviations: N1, implemented the CDSS; N2, did not implement the CDSS.
Examples of the data extracts are given for both nursing homes.

and RNs. Unfortunately, they often lack familiarity with the patients, and the CDSS could support their assessments.

Curb Administrative Hassle

The RNs' attitudes toward computer use can affect the implementation of a CDSS. Some RNs were reluctant to use the CDSS because it was yet another computer system added to the several other systems that they had to use. They expressed both fear and aversion to learning about a new system, referring to the "administrative hassle." The many different computer systems requiring constant logins and logouts constitute one such hassle. The aversion could also involve a general reluctance to use computers. Another impeding factor is the workplace itself, in which there is a need for more than one computer and monitor.

Set Requirements From Managerial Positions

Management must be committed and require that the CDSS be implemented and used for drug monitoring. This includes providing guidelines and requirements for the implementation to take place. Some RNs suggested that the physicians should also be given reasonable prerequisites to perform systematic drug reviews and use the CDSS in this process. Others argued that conducting the drug reviews was not a choice because, according to Swedish regulations, they must be done and that the question was actually about how they should be done. In addition to making demands, management should provide the proper resources in terms of education and opportunities for continuous training.

DISCUSSION

The aim of this qualitative study was to identify the conditions required for the successful implementation of a CDSS used by RNs for drug monitoring. The findings showed that the RNs' experiences in many aspects were consistent with those generally described regarding the implementations of CDSSs for RNs in nursing care; however, additional aspects emerged. In order to gain a more profound understanding of the findings of the present study, the results were also discussed in relation to implementation theory, Rogers'[31] Theory of Diffusion, which is applied widely in implementation research.

The RNs expressed a need to see benefits and results that could apply to both the patients and themselves as a condition for implementing the CDSS. Similar results were reported by de Veer et al,[21] who found that RNs were more willing to use new technology when they believed that patients would benefit from it. Similarly, Fossum et al[20] referred to usefulness as a key facilitator in CDSS use. Another condition dealt with "administrative hassle," which referred to the RNs' reluctance to start using an additional computer system. The reluctance was primarily connected to issues with their work environment and the limited integration between the CDSS and the other computer programs that they used, which are barriers that have been reported previously.[20] The RNs in this study did not express any views about the technology itself, which otherwise is a commonly occurring issue regarding its successful implementation.[20–23] However, they emphasized that adequate CDSS training and education were an important condition. The lack of training is a commonly reported impeding factor for RNs in the use of informatics.[3,20,23]

The time perspective appeared in these findings, as it did in previous research;[3,19,23] RNs report the lack of time as a reason for not using new technology. However, in the present findings, the time constraints did not primarily refer to the RN's own time, but rather the physician's time. A likely explanation would be that physicians are ultimately responsible for drug treatment; thus, they need to take the time to listen and discuss the treatments with the RNs, view the CDSS reports, and make the necessary adjustments in the treatments. The issue of responsibility also appears in relation to the RN's own duties. There was a fundamental difference between the RNs in their own commitments and perceptions of their drug monitoring responsibilities. Some of the RNs stated that it was primarily in their own interest to use the CDSS and then involve the physicians in order to provide the safest treatments possible. Others took a more "pending" position, waiting for the physicians to request the use of the CDSS. Thus, the RN's own interest and sense of responsibility for drug monitoring appeared to affect the implementation process. The physicians' engagement was previously identified as a condition for the successful implementation of a CDSS in nursing care, even though RNs proved their ability to implement the new technology without their engagement, if they found it useful enough.[32] However, as in the present study, when an area commonly regarded as a physician's domain was involved, the question of responsibility probably needs to be discussed and stated in tandem with introducing a CDSS.

The RNs explained that collaboration is an important condition for the successful implementation of a CDSS. They referred to collaboration on several levels, including the different professions, the management, among themselves, and the patients. These findings might be linked to the specific area, since interprofessional collaboration has been widely advocated as a condition for safe drug monitoring,[33,34] including the use of a CDSS.[19] The establishment of routines and guidelines for the work process were expressed as benefits of the collaboration, as well as clear requirements from those in managerial positions.

When viewing the present findings in relation to Rogers'[31] Theory of Diffusion, several similarities could be seen. In the present study, the RNs' experiences were clearly associated with what Rogers[31] refers to as "the relative advantages," meaning the degree to which an innovation is perceived as better than the existing practice. This was expressed as one of the conditions in terms of the need to see the benefits of using the CDSS. These benefits involved not only the working routines, but also the patients, in terms of safer medication treatments. When this condition was not met, that is, when there was a lack of an effect on the drug treatments, it probably affected the implementation. This can also be associated with what Rogers[31] refers to as "observability," or the visibility of the innovation to others. The more visible the results, the more likely the innovation will be adopted. The RNs' different attitudes toward whether it was their responsibility, or even in their interest, to use the CDSS could be associated with the "compatibility," or the degree to which an innovation is perceived as consistent with existing values and beliefs. Therefore, an innovation can be incompatible with embedded values as well as previously adopted ideas, which might have been one explanation for the different outcomes in the present study. The "complexity," or the perceived difficulty in understanding and using the innovation, may not be as important as the relative advantages or compatibility, but is, in the present findings, visible in the condition referred to as curbing administrative hassle. However, the RNs did not clearly express any condition related to the "trialability," meaning the degree to which an innovation can be experimented on with limited basis. However, trialability is, according to Rogers,[31] commonly perceived as more important by relatively new adopters, and the RNs in the present study might not be seen as new adopters because they had been using the CDSS for several months.

Strengths and Limitations

The interesting features of the present study are that it was conducted in nursing homes, which are rare settings for studies in nursing informatics,[1] and it displayed the RNs' perspective, even though the use of a CDSS in this area commonly applies to physicians and pharmacists.[12,13] One limitation was the size of the study; it was a case study, which of course limits the transferability of the findings. However, although given similar preconditions, the fact that the implementation was only successful in one of the two nursing homes might contribute to

a greater understanding of the conditions required for implementing such technology. Another limitation was that the author, who conducted the focus group discussions, had been involved in the process of introducing the CDSS in the nursing homes, which may have made the RNs reluctant to express critical opinions. However, this might also have had the opposite effect, and the RNs may have felt more comfortable expressing their views.

Conclusions and Implications

One contribution of this study was that the specific conditions for implementing a CDSS intended to support RNs in drug monitoring were identified. The conditions that appeared to differ most from the other implementations of CDSSs in nursing care involved the question of responsibility and collaboration. There were fundamental differences in the RNs' own interests, commitments, and perceptions of their responsibilities toward implementing and using the CDSS, which were basically related to their views about the division of the responsibilities of drug monitoring between themselves and the physicians. Thus, these matters need to be discussed and resolved to lay the foundation for a successful implementation. The need for collaboration is another prominent condition. Interprofessional collaboration has previously been described as an important prerequisite for safe drug monitoring,[33,34] and this also seems to apply to the implementation and use of a CDSS. Thus, emphasis should be placed on establishing procedures for cooperation in the use of the CDSS, which in turn requires that the organization as a whole be prepared for technological innovation. According to Doran et al,[23] it is of great importance to consider organizational readiness before implementing a new technology, which, according to the present findings, should apply to both the professionals involved and the management. Thus, the preparations involved in the introduction of a CDSS utilized by RNs for drug monitoring could involve discussions about the expected benefits as well as the planning of collaboration, routines, and responsibilities, mainly between the RNs and physicians but also in relation to unlicensed staff. Apart from that, educational issues and work environment need to be considered.

Further research involving the nursing informatics implementation process is needed. Preferably, those studies should focus on the specific context in which the informatics is used instead of having a general perspective. In this way, guidelines may be created that fit the specific context and facilitate the implementation process.

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